ENV. LAB 2719

UNHOLTZ-DICKIE CORPORATION

vibration generation systems and measurement instruments

OPERATING INSTRUCTION MANUAL
MODEL TF11 SN 395, 396, 397

OPERATING AND SERVICING INSTRUCTIONS

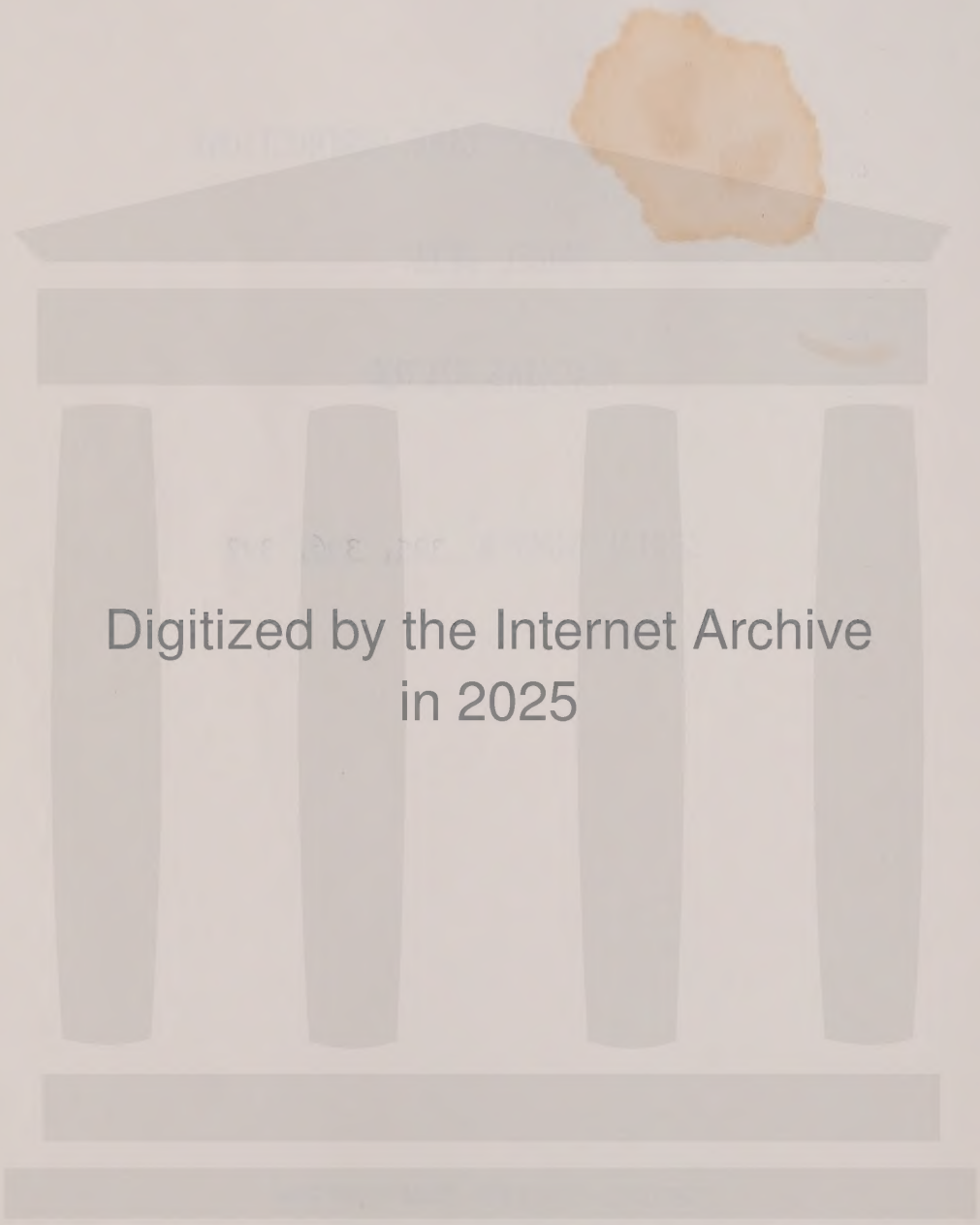
MODEL TF11

TRACKING FILTER

SERIAL NUMBER 395, 396, 397

UNHOLTZ-DICKIE CORPORATION
3000 WHITNEY AVENUE
HAMDEN, CONNECTICUT 06518

203 265-3929
LEE MOORE
SERVICE TECH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1. GENERAL DESCRIPTION AND INTRODUCTION

Any vibration test that requires filtering of one acceleration channel, should have filtering available on all channels. The TF11 has been designed as a compact economical instrument to provide the same performance at one-half the price and one-sixth the panel space of competitive units.

The TF11 is a unity gain Tracking Filter with continuous variable constant 10% bandwidth. The upper and lower bandwidth limits are adjustable. A fixed bandwidth from 2 Hz to 200 Hz can be selected. Fig. 1.1 shows the front of the TF11, and a block diagram of a typical test setup is shown in Fig. 1.2. Oscillators other than the U-D Model OSC-1 may require certain precautions listed in Section 4.6.

Interchangeable mounting with Model D22 Charge Amplifiers allows the TF11 to be mounted next to the corresponding Amplifier in a multichannel system.

Utilizing the low distortion output from the OSC-1 Sweep Sine Generator, the TF11 has no unnecessary duplication of circuitry. Co-Quad circuitry eliminates the possibility of "loss of lock" at high sweep rates or low input levels.

The OVERLOAD detector on input is connected to system interlock to prevent run away of system. The RANGE, BANDWIDTH and BYPASS switches are also connected to the interlock.

In the BYPASS mode, the rear filter OUTPUT is connected directly to the INPUT and the interlocks are bypassed to allow the TF11 to be used as a monitor. The front panel OUTPUT remains connected to the filtered unity gain output.

NOTICE: For operation with Tuning generators other than OSC-1 after SN 155 see Section 4.6 of this manual.

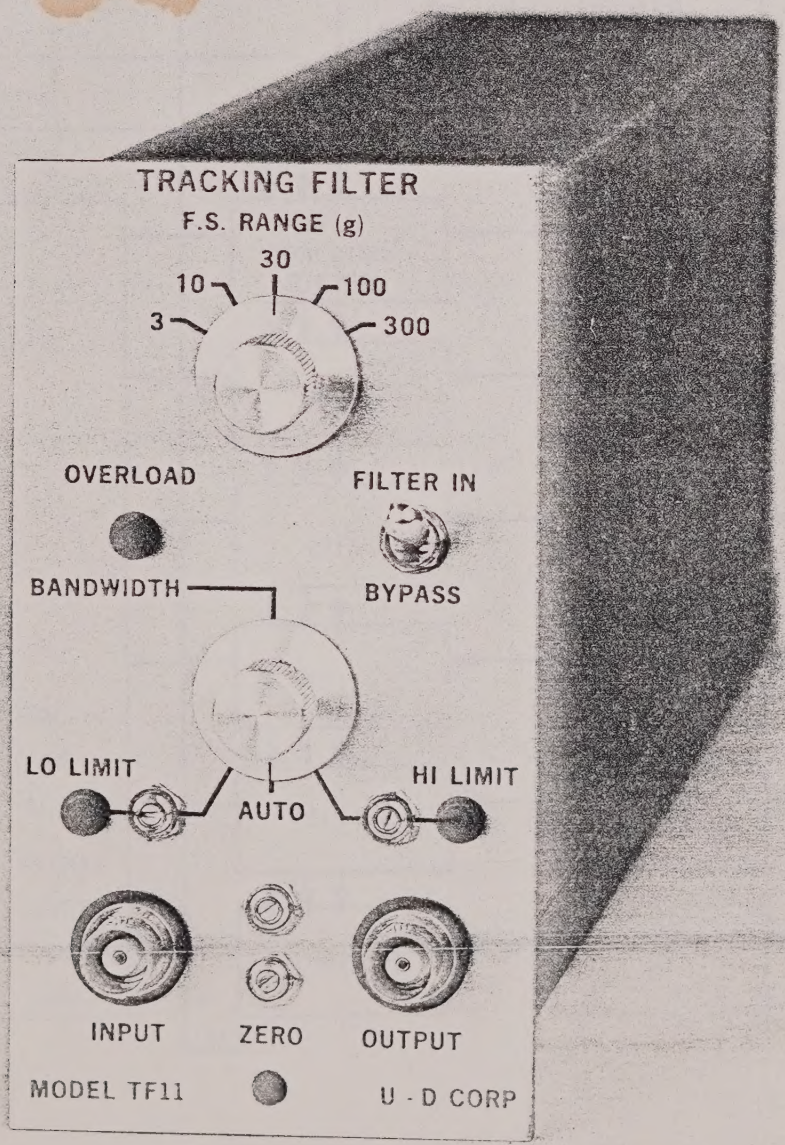
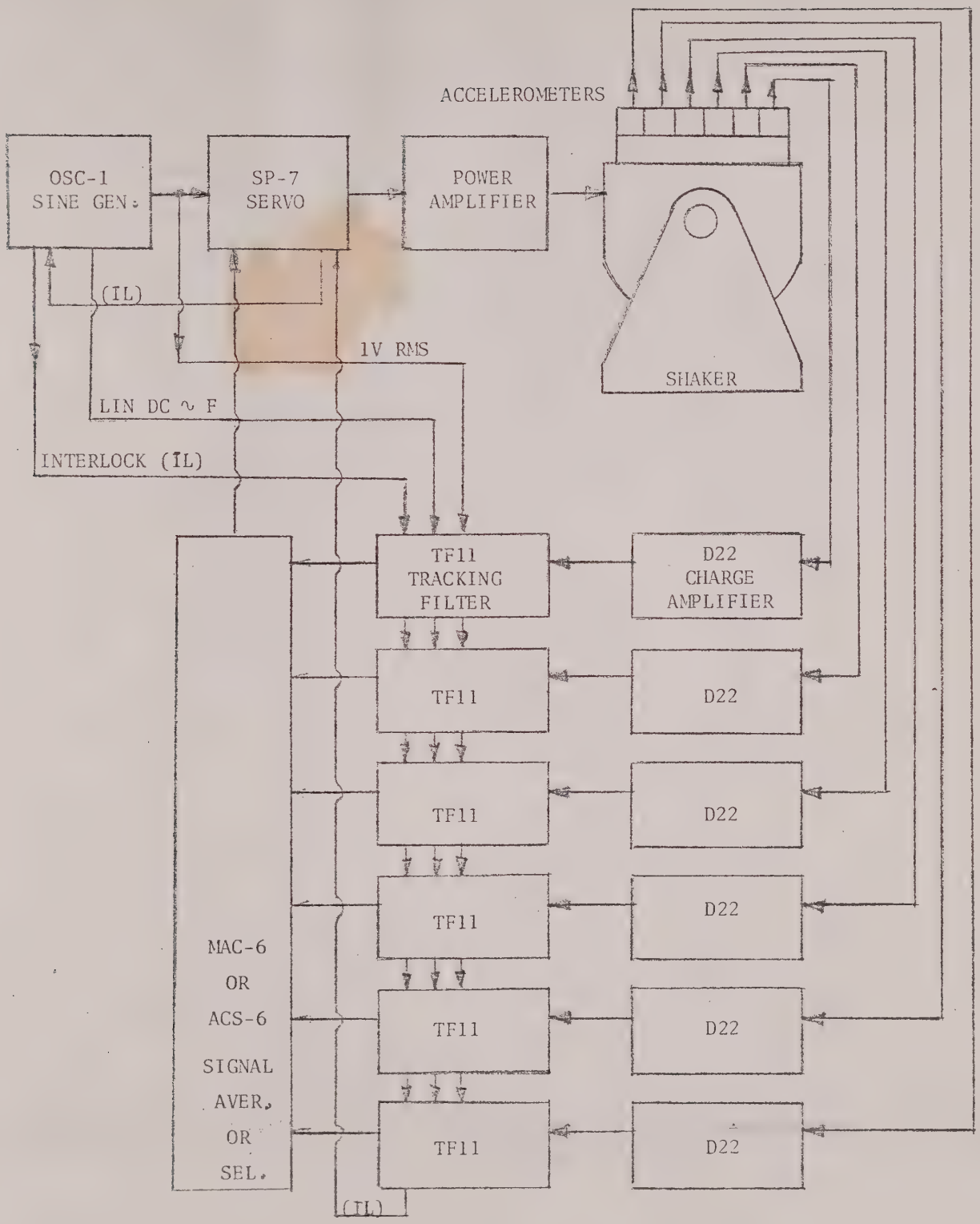


Fig. 1-1
Front View of TF11



TYPICAL TEST SETUP WITH TF11

FIG. 1.2

2. SPECIFICATIONS

2.1 Inputs

2.1.1 Signal

Frequency Range:	5 Hz to 5 kHz
g ranges:	3, 10, 30, 100 and 300 g (peak) nominal
Overload:	The overload detector activates at approx. 3 dB above full scale to allow distortion or noise in addition to a full scale signal
Sensitivity:	10 mV peak/g peak
Impedance:	20 kilohm

2.1.2 Tuning

Frequency Range:	5 Hz to 5 kHz
Amplitude:	.3V to 3V rms sine wave
Impedance:	20 kilohm

2.1.3 DC vs Frequency (generated internally on TF11-L)

Amplitude:	10 mV at 5 Hz to 10V at 5 kHz, linear DC voltage vs frequency used to program filter bandwidth
Impedance:	10 kilohm

2.2 Outputs

2.2.1 Filtered Signal

Frequency Range:	5 Hz to 5 kHz
Amplitude:	Unity gain
Frequency Response:	±0.5 dB
Impedance:	100 ohm, 2 mA pk-pk max.
Linearity:	±0.5 dB + 0.3% of full scale 0 dB to -50 dB at 400 Hz
Dynamic Range:	66 dB (overload to noise floor)

2.2.2 Log DC

Amplitude:	50 mV/dB, 0V at F.S. (-2.50 V at -50 dB)

Conformity:	±0.25 dB, 0 to -40 dB, ±1 dB, to -50 dB
Impedance:	50 Ω

2.3 Selectivity

2.3.1 Bandwidth:	10% of tuning frequency between limits
2.3.2 Bandwidth Limits:	Lower limit 2 Hz - 20 Hz Upper limit 20 Hz - 200 Hz
2.3.3 Filter Response:	Minimum 50 dB rejection at ±8 times ½ bandwidth points (Approx. 3 pole Butterworth)

2.4 Indicators

2.4.1 Overload:	Indicates overload of input
2.4.2 Lo Limit:	Indicates BW is fixed at lower limit
2.4.3 Hi Limit:	Indicates BW is fixed at high limit

2.5 Interlocks: Interlocks are provided to place the vibration-equipment in STANDBY (no vibration) when:

2.5.1 The RANGE control is switched

2.5.2 The BANDWIDTH control is switched

2.5.3 The OVERLOAD detector is triggered

2.5.4 The FILTER IN BY-PASS control is switched (in BY-PASS all interlocks are by-passed)

2.6 Connections: All connections are at the rear of the chassis. A second INPUT connector and an OUTPUT connector from the filtered unity/gain output are provided on the front panel for monitoring purposes.

2.6.1 Inputs and Outputs:	BNC connectors are provided for SIGNAL IN, SIGNAL OUT, LIN DC v Frequency IN, LOG. DC proportional to filtered Output, TUNING IN.
2.6.2 Aux. Control:	A 25 pin "D" series connector is used for interlocks and to parallel patch tuning inputs and DC input between parallel channels

2.7 Signal Ground: A switch on the rear panel selects the signal ground to be connected to the AC line ground or to be floating (grounded through signal inputs and outputs).

REV: 1/17/74
7/12/74
11/5/74

2.8 Power: 105-125/210-250 V AC, 50-60 Hz, approximately 10 watts

2.9 Weight: 6 pounds

2.10 Size: 5.25 H x 2.8" W x 18" D. Uses Model 22RA Rack Adapter for six channel.

3. DESCRIPTION OF CONTROLS AND CONNECTORS

3.1 Front Panel (See Fig. 1.1)

3.1.1 F.S. RANGE - This 5 position switch selects the optimum operating range of 3.16, 10, 31.6, 100 or 316 g peak (10 mV/g). Each range has an approximate 3 dB over range before the OVERLOAD activates the interlock to allow for some distortion and/or noise signal in addition to a full scale input sine signal.

3.1.2 OVERLOAD Indicator - This LED indicator flashes when peaks of the input signal exceed full scale plus approximate 3 dB of the selected F.S. RANGE.

3.1.3 FILTER IN/BYPASS - In the FILTER IN position the signal OUTPUT on the rear of the TF11 is connected to the unity gain filtered signal. In the BYPASS position the signal OUTPUT is connected to the signal INPUT; the TF11 is deactivated in the BYPASS mode.

3.1.4 BANDWIDTH Mode Selector - A 3-position switch which selects the mode in which the bandwidth changes with change of the tuning frequency.

LO LIMIT - The bandwidth is fixed 2-20 Hz as selected by the LO LIMIT control.

AUTO - The bandwidth changes automatically as the tuning frequency changes between the limit selected by the LO LIMIT and HI LIMIT controls.

HI LIMIT - The bandwidth is fixed 20 - 2000 Hz as selected by the HI LIMIT control.

3.1.5 LO LIMIT Indicator - Lights when the BW is fixed at the LO LIMIT.

3.1.6 LO LIMIT Selector - This screw driver adjustment selects the LO LIMIT Bandwidth 2-20 Hz.

3.1.7 HI LIMIT Selector - This screw driver adjustment selects the HI LIMIT Bandwidth 20-200 Hz.

3.1.8 HI LIMIT Indicator - Indicates when the BW is fixed at the HI LIMIT

3.1.9 INPUT - This connector is in parallel with the rear INPUT and is intended for monitoring purpose.

3.1.10 ZERO - These screw driver adjustments are made easily accessible for the operator to adjust for optimum dynamic range.

3.1.11 OUTPUT - This connector makes the filtered unity gain accessible for monitoring purposes regardless of the position of the FILTER IN/BYPASS selector.

3.2 Rear Panel (See Fig. 3.1)

3.2.1 POWER - 3-prong connector for AC power input mates socket in U-D Model 11RA Rack Adapter.

Pin 1 (bottom) AC ground
Pin 2 (center) AC common
Pin 3 (top) 115 V/230 V AC 50/60 Hz

3.2.2 FUSE - GMW-1/2

3.2.3 EXT GND/INT GND Selector - Connects signal common of TF11 to Power Ground (INT) or isolates it (EXT)

3.2.4 AUX. CONTROL - A 25 pin rear panel connector provides for auxiliary system interconnections as described in thefollowing list. (See Table 3.1 for Pin Function)

3.2.5 INPUT - Unfiltered Signal Input

3.2.6 OUTPUT - Signal Output is connected either to unfiltered Signal Input (BYPASS) or to unity gain filtered output (FILTER IN).

3.2.7 TUNING - Input for reference AC signal OSC-1; used to tune the TF11. (.3V - 3V rms)

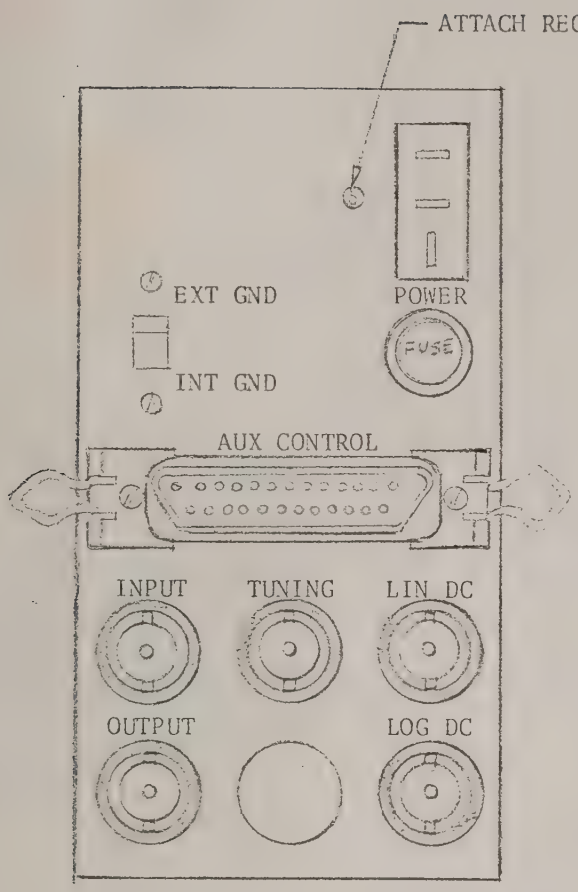
3.2.8 LIN DC - Input for 10 mV to 10 V DC (2 mV/Hz) signal from OSC-1; used to adjust to bandwidth of the TF11 in the AUTO BW mode. On TF11-L this signal is generated internally and available on LIN DC connector for interconnection to other TF11's without "-L" option.

3.2.9 LOG DC - Output for DC signal proportional to the log of the full scale filtered AC; may be used to plot the filtered signal on an X-Y Plotter.

3.3 Internal Switches

3.3.1 DISPLACEMENT Mode Switch. (This switch can be reached through the ventholes in the top cover; use an eraser tipped pencil to raise the lever)

Lever up: DISPLACEMENT MODE



REAR VIEW TF11

FIG. 3.1

TABLE 3.1

AUX. CONTROL PIN FUNCTION

PIN NO.	FUNCTION
1 & 14	TUNING - Reference AC Input, from OSC-1 Sweep Sine Generator tunes the filter. This connection is in parallel with TUNING BNC connecter and may be used to patch tuning signal between TF11's in a multi-channel system (0.3 to 3V rms.)
2 & 15	LIN DC - 10 mV to 10 V DC Input signal, proportional to frequency (2mV/Hz) adjusts Bandwidth of TF11 in AUTO BW mode. This connection is in parallel with LIN DC BNC connector and may be used to patch the LIN DC signal between TF11's in a multi-channel system (see Fig. 4.1). On the TF11-L this is an output signal.
3 & 16	SINE - normalized reference AC Sine signal. May be used to slave a TF11 without A-TF11 Board. (5V rms)
4 & 17	COSINE - Normalized reference AC cosine signal; may be used to slave a TF11 without A-TF11 Board. (5V rms)
5	BW CONTROL - 40 mV-4V DC proportional to Bandwidth; may be used to slave limit controls in a multichannel system.
12 & 13	COMMON for LIN DC and TUNING signals, 50Ω to internal SIGNAL GND.
24 & 25	INTERLOCK - Used as an external series interlock connection, usually connected in series with the internal interlock series or a vibration excitor control servo (SP-7). The connection between 24 and 25 is NC and opens momentary when either of the RANGE or BANDWIDTH or FILTER IN/BYPASS controls is changed. Also, the connection is momentarily interrupted when the OVERLOAD detector is triggered. In BYPASS the interlock is held closed.

3.3.1 (cont'd)

Lever down: NORMAL

In the DISPLACEMENT Mode the TF11 goes automatically into BYPASS when the BANDWIDTH switch is in AUTO and the LO LIMIT light is on and the RANGE switch is in 30, 100, or 300 g. (See also Section 4.8)

Notice that the front OUTPUT is always connected to the filtered signal.

4. OPERATION

This section describes the operation of the TF11 in typical systems. If the TF11 is purchased as part of a large system, refer to the systems manual for specific installation, calibration and operating instructions.

4.1 Operational Checkout Procedure

Sections 6.1 through 6.3 can be used as a quick initial checkout procedure.

4.2 System Interconnection for Multiple TF11's

Fig. 1.2 shows a typical system using several channels of Tracking Filters. Fig. 4.1 shows the interconnection of the control signals (TUNING SIGNAL, LIN DC vs FREQ., INTERLOCK). All interconnections between TF11's are made through the AUX CONTROL connector.

The TUNING signal and the LIN DC v. FREQ. signal can be connected to any of the interconnected TF-11's.

4.3 System Grounds (Line Frequency Interference)

4.3.1 INT - EXT GROUND - As most instruments manufactured by Unholtz-Dickie Corp. the TF11 has isolated signal common, which can be connected to the Power Ground by a switch at the rear panel. In a system usually only one instrument is grounded INTERNAL all other EXTERNAL (through the shields of the interconnecting cables). Which instrument should be grounded is usually determined by trial.

4.3.2 Differential Input - In cases of extreme interference, the TF11 may be operated with differential input; to do so remove shorting strap between the commons of INPUT and OUTPUT connector at the rear of the instrument. (See Fig. 8.1)

Notice that any signal conditioner connected to the differential TF11 has to be grounded INTERNAL unless grounded through the accelerometer or other devices.

4.4 Output Zero

Before using the TF11, the output may have to be re-adjusted for Zero feedthrough of the tuning signal. Although the instrument usually settles within several minutes after power is turned on it is advisable to allow 15 minutes warmup for operation over the full dynamic range.

4.5 Adjustment of Bandwidth Limits

The limits of the constant percentage (10%) bandwidth range may be adjusted by using the LO LIMIT and HI LIMIT screw-driver adjustments. To set limits, set bandwidth switch to AUTO and select on SINE GENERATOR a frequency of 10 times the desired bandwidth limit. Adjust screw driver adjustment until LIMIT indicator just lights.

Notice: An ideal bandpass cannot be operated at a center frequency below½ of the bandwidth. Typically in a 3-pole pair tracking filter such as the TF11 an output error in excess of .5 dB is observed at tuning frequencies less than .65 X BW.

4.6 Sine Generators Other Than OSC-1 After SN 155

The TF11 Tracking Filter is designed to be used with the OSC-1 Sine Generator on range 5 Hz to 5 kHz. When used otherwise the following precautions must be considered.

4.6.1 OSC-1 Before SN 156 on RANGE 2 Hz - 2 kHz - The LIN DC output on any RANGE is 10 mV - 10 V; therefore on RANGE 2 kHz the AUTO bandwidth will be 25% instead of 10% and the frequency range of the LO LIMIT and HI LIMIT controls will be 8 Hz to 80 Hz and 80 Hz to 800 Hz. On OSC-1's after SN 155 the LIN DC on any RANGE is 2 mV/Hz to insure proper operation.

Solution: Use on RANGE 5 kHz only or consult factory FOR MODIFICATION OF LIN DC output (or use TF011-L).

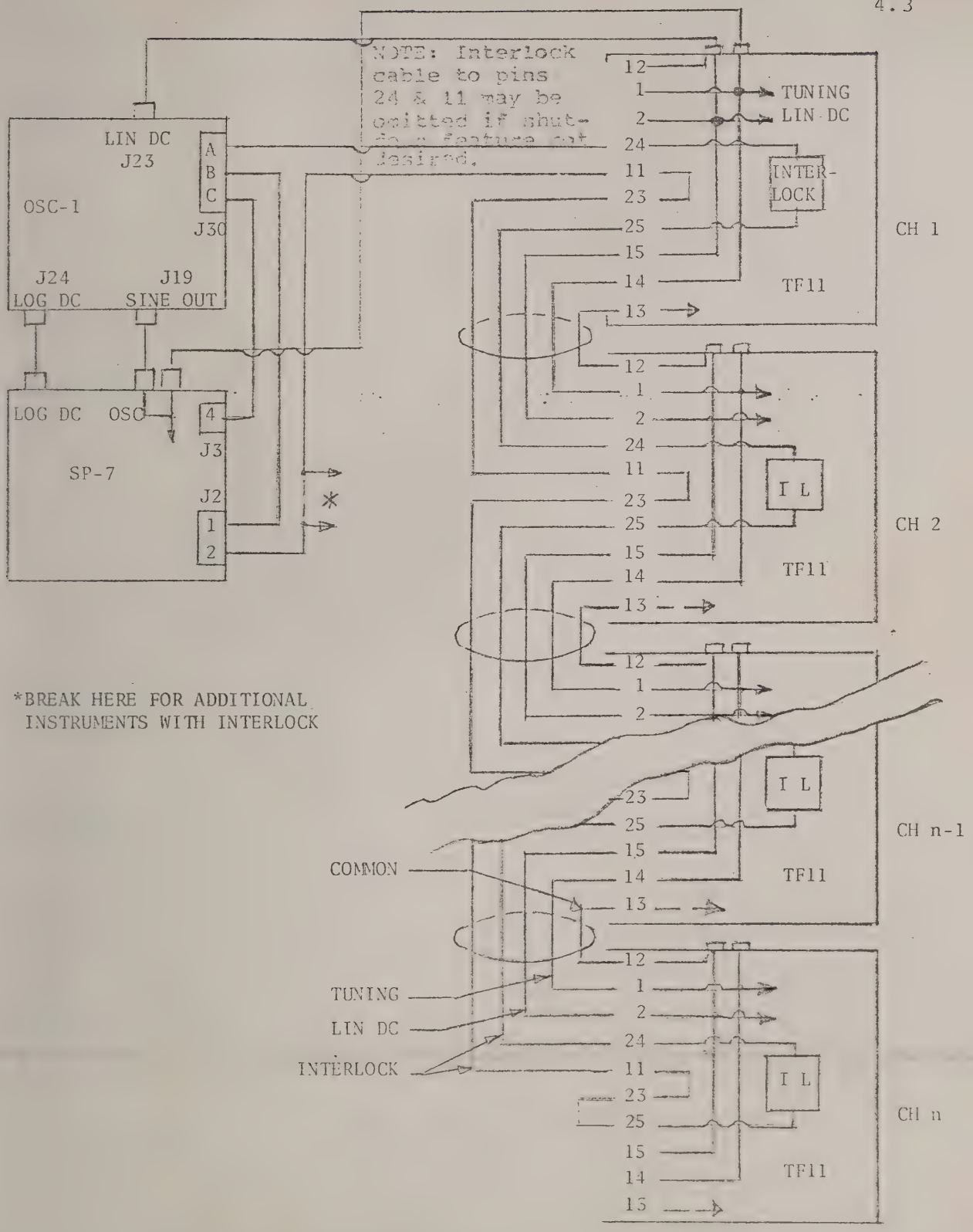
4.6.2 SD104A-5 on Ranges other than X1 (5 kHz) - Synonymous to 4.6.1 the bandwidth control will work properly only on the 5 kHz range (MULTIPLIER X1).

Solution: Use on MULTIPLIER X1 only or use TF11-L (with internal LIN DC generator) or consult factory for modification of TF11 (Option "-SD5").

4.6.3 SD104A-1 and SD104A-2 - Synonymous to 4.6.1 no MULTIPLIER setting will yield proper bandwidth control.

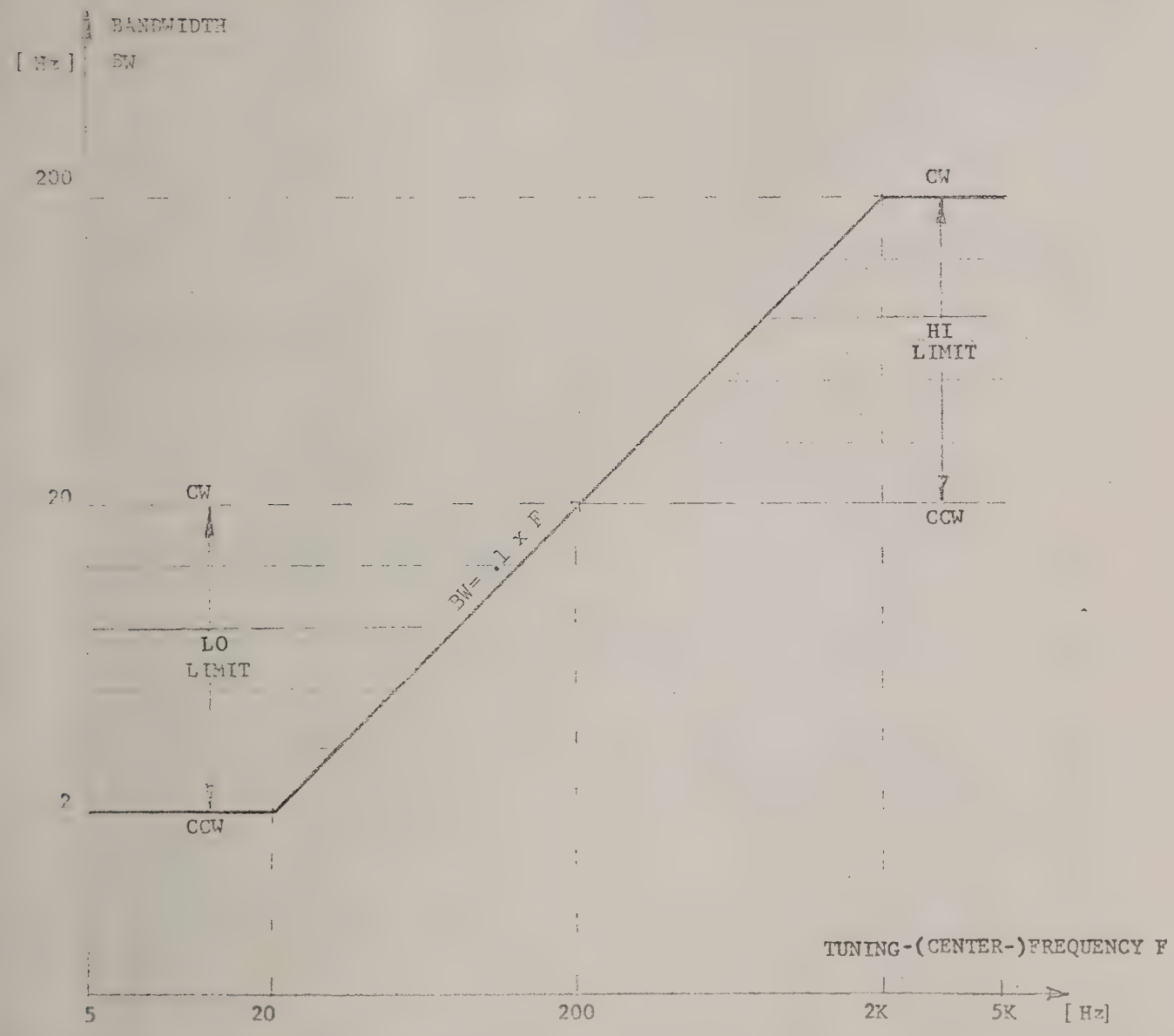
Solution: Use TF11-L (internal LIN DC generator) or consult factory for modification of TF11

4.6.4 SD114A - No precaution necessary.



TYP. INTERCONNECTION THROUGH AUX CONTROL CONN.

FIG 4.1



BANDWIDTH VS. TUNING-(CENTER-)FREQUENCY IN THE AUTO BANDWIDTH MODE

FIG. 4-2

4.6.5 B & K Auto Vibration Excitor Controls - Models 1016, 1018, 1019, 1008, 1025 - These instruments do not have a LIN DC vs. FREQUENCY Output. Also some models do not have a constant level output for use as TUNING Signal.

Solution: Be sure the B & K Controller has either internal constant level signal or external "COLA" unit (SD Model SD-11), and use TF11-L.

4.6.6 Others - Most other sine generators require the use of TF11-L. Also be sure a constant amplitude tuning signal .3V - 3V RMS is available.

4.7 Operation In A Typical System

4.7.1 Be sure tuning generator and TF11 are range compatible (See Section 4.6)

4.7.2 Apply power and let system warm up for at least 10 to 15 minutes.

4.7.3 Set TUNING Generator approximately to center of desired frequency range.

4.7.4 Switch TF11 to RANGE 300 g and adjust ZERO pots for minimum feed through of tuning signal (typical 2 mV rms or .3 g)

4.7.5 Set RANGE switch to max. expected acceleration. The TF11 has approx. 60 dB dynamic range when properly zeroed. Since many constant displacement tests require input variations of 45 dB it is important to select a range as close to the max accel. as possible to conserve usable range.

4.7.6 Set Bandwidth LIMIT pots (see Sec. 4.5 and 4.8). Normally LO LIMIT pot is set fully CCW, HI LIMIT pot fully CW. After adjustment select "AUTO".

4.7.7 Due to extreme noise signals (rattles in specimen or harmonic resonances) shutdown of Servo (SP-7) may occur due to overdriving the TF11. In that case select nearest high acceleration range on TF11.

4.8 DISPLACEMENT Mode

When using the TF11 over a larger dynamic range in the servo loop of a shaker system (such as constant displacement over a large frequency range), it may be desirable to bypass the filter as the signal approaches the noise floor. An internal switch (see section 3.3.1) selects a mode in which the TF11

4.8 (cont'd)

goes into BYPASS when the tuning frequency goes below the LO LIMIT frequency. This mode is only active when the BANDWIDTH switch is at AUTO and the RANGE switch is at 30, 100, or 300g. (When used with D22-T, see also Section 4.9)

4.9 Operation With D22-T Charge Amplifier

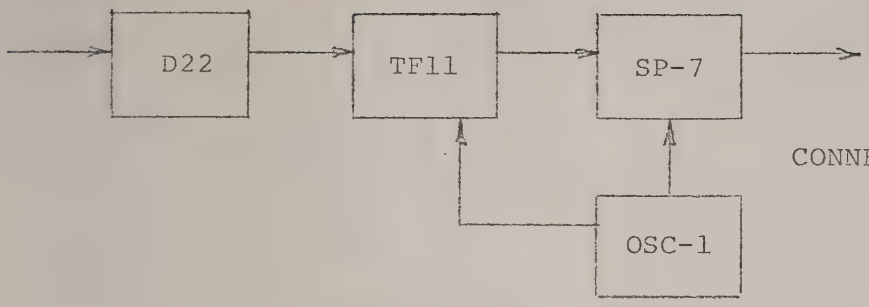
When using the TF11 with the Model D22-T Charge Amplifier (with tracking filter option) the ranges are shifted, since the signal from the D22 "TF" OUTPUT is not 10 mV/g, as it is from the "SERVO" OUTPUT. The used RANGE switch positions are as follows:

D22 RANGE	USE TF11 RANGE
1	10
3	30
10	100
30	300
100	300
300	300
1k	300

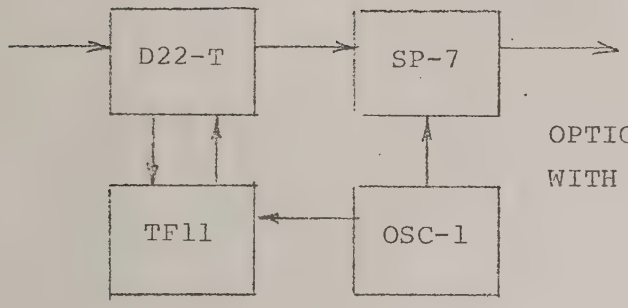
An overlay decal is available from U-D Corp., which can be affixed to the TF11 panel. It indicates in conjunction with a double pointed knob, both ranges (see FIG. 4.3).

Notice: When used with the D22-T the "Displacement Mode" of the TF11 may have to be changed. Sections 3.3.1 and 4.8 describe the "Displacement Mode". In this mode the TF11 goes automatically into BYPASS as the output signal approaches the noise floor. The "Displacement Mode" is not active on ranges 3g and 10g, since constant displacement tests over a large frequency range are unlikely in those acceleration ranges. Therefore it may be desirable to defeat the displacement mode on ranges 100g and lower (10g and lower on D22).

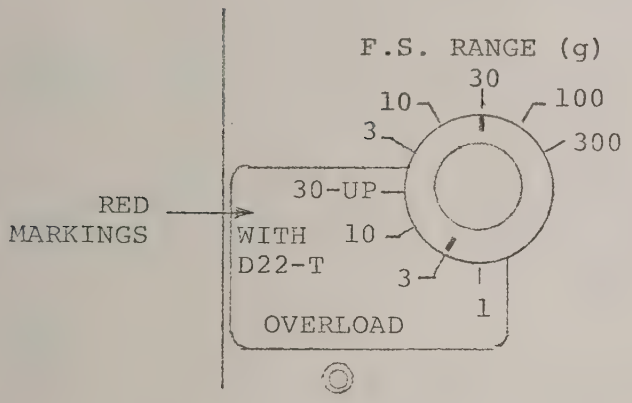
Although the DISPLACEMENT MODE switch (internal to the TF11, see Fig. 6.3) can be used to enable or disable the "displacement mode", it is more convenient to rewire the RANGE switch as shown in Fig. 4.3 and Fig. 8.1.



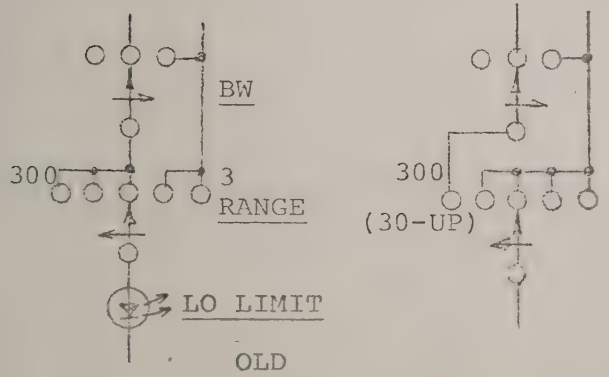
CONNECTION WITH D22



OPTIONAL CONNECTION
WITH D22-T



RANGE CONVERSION DECAL



MODIFICATION OF RANGE
SWITCH TO DEFEAT
DISPLACEMENT MODE ON
ALL RANGES EXCEPT 300g
(30-UP WHEN USED WITH D22-T)

OPERATION WITH D22-T (SEE SECTION 4.9)

FIG. 4-3

5. THEORY OF OPERATION AND CIRCUIT DESCRIPTION

A block diagram of the TF11 can be found in Fig. 5.1. Fig. 8.1 shows a detailed block diagram, and the circuitry of the individual PC boards is shown in Section 8.

5.1 Theory of Operation

For the purpose of description, it is assumed that the tuning frequency is 500 Hz (sin ωt) and the input signal contains a 500 Hz component of amplitude A and phase ϕ relative to the tuning signal [A sin $(\omega t + \phi)$] plus a distortion signal at 1000 Hz (B sin 2 ωt). A COSINE tuning signal (cos ωt) is generated in the TF11.

In the CO-demodulator the input signal is modulated by the SINE tuning signal and the output contains a:

Zero Hz component	A cos (ϕ)
1000 Hz component	A cos $(2\ \omega t + \phi)$
500 Hz component	B cos (ωt)
1500 Hz component	B cos $(3\ \omega t)$

In the following filter all AC components are filtered out, and only the A cos ϕ component remains. Conversely, the filtered output of the QUAD-demodulator is A sin ϕ.

In the modulators the DC signals are modulated again by the SINE and COSINE signal. The outputs are A cos ϕ sin ωt and A sin ϕ cos ωt, the vector sum of which is A sin $(\omega t + \phi)$, the 500 Hz component of the input signal.

5.2 Circuit Description

5.2.1 The Auto Gain and Phase Control (Board A) generates the SINE and COSINE for the CO and QUAD modulators (multipliers).

The TUNING signal, which may vary from .3 to 3V rms is amplified to 5V rms in Z1 (BoardA). A meter-integrator circuit controls the variable resistor V1 to stabilize the output voltage.

The SINE signal is phase rotated in the variable ALL-PASS, which rotates the phase vector of the SINE signal through the first and second quadrant depending upon frequency and value of V2. Z3 is a phase comparator. The average of the output signal at TP-2 is OV when the phase vectors of the two inputs (SINE and COSINE) are 90^{o} apart. The error signal is integrated and fed back to V2, the control element of the ALL-PASS.

5.2.2 The I/O Buffer and Log Meter (Board B) contains amplifiers to buffer the normalized (attenuator) input signal and the restored (unity gain) output signal. A peak detector detects when the input signal exceeds the dynamic range of the TF11 Tracking Filter.

Z3, Z4 and Z5 comprise a log meter circuit which is connected to the normalized filter output.

5.2.3 Each of the Modulator Boards (DC and DQ) contain two multipliers connected as double balanced modulators.

The first modulator demodulates the input signal by multiplying the input signal by the reference SINE (COSINE) signal. The DC component of the signal at the output (pin K) is proportional to the CO (QUAD) component of the input signal. After filtering out all AC components in the LO-PASS filter the DC component is multiplied (modulated) by the reference SINE (COSINE) signal. The resulting CO (QUAD) signal is added to the QUAD (CO) signal of the other channel on the DC Board. The corresponding amplifier on the DQ Board removes the DC component of the filtered signal.

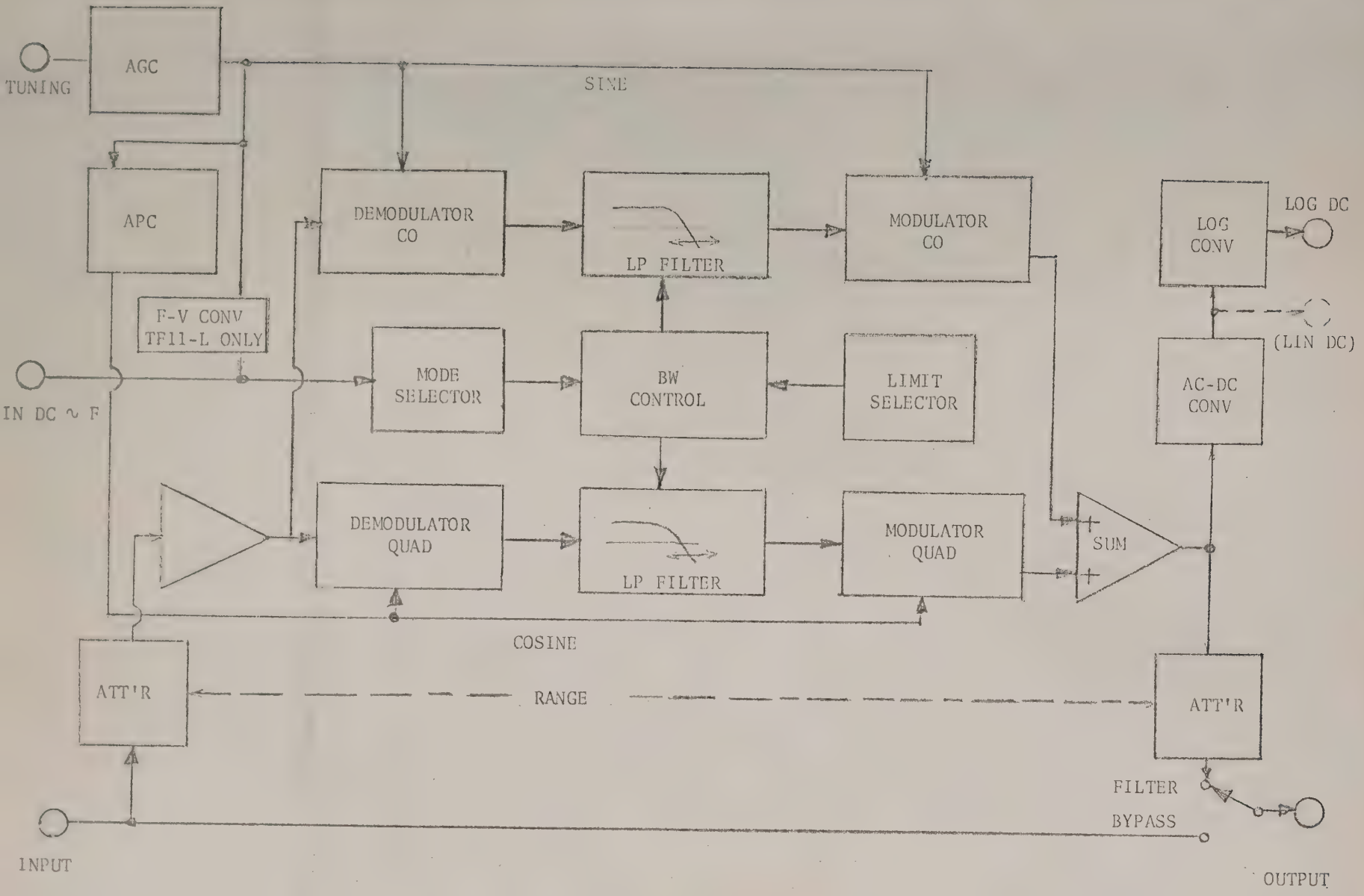
5.2.4 The Filter (Board F) is a dual channel voltage controlled LO-PASS.

The controlling signal is the LIN DC vs FREQUENCY signal from the TUNING generator (OSC-1). The two sections of Z1 limit this DC signal to the range set by the HI LIMIT and LO LIMIT controls. The EVRs (electrically variable resistors) are selected to track within 6 dB and the desired characteristic of resistance inversely proportional to frequency is obtained by placing one EVR (V1) in a feedback circuit.

The two filter sections have approximately three-pole Butterworth transfer function.

5.2.5 The optional (TF11-L only) LIN DC Connector (Board L) is a Frequency to Voltage converter.

The Sine reference signal is amplified proportional to frequency in a differentiating amplifier and then rectified in the following full wave rectifier.



BLOCK DIAGRAM TF11

FIG. 5.1

6. MAINTENANCE & CALIBRATION

The instrument has been adjusted and calibrated at the factory and under normal conditions no readjustments except for front-panel ZERO adjustments are necessary. However, if prolonged use, customer calibration procedures, or major replacement of components make adjustments necessary, the procedure outlined in Section 6.1 through 6.6 with the instrument covers on should be followed. Remove the covers for further checking and adjustment only if malfunction or out-of-tolerance performance is suspected. ALLOW THE INSTRUMENT TO WARM UP AT LEAST 15 MINUTES BEFORE ATTEMPTING CHECKOUT OR CALIBRATION.

6.1 Instruments and Connections

Refer to the Table 6.1 below for instruments and to Table 6.2 for instrument connections.

DESCRIPTION	TYP. MODEL	USE
Sine Generator - 5 Hz to 5 kHz .3V to 3V rms Linear DC vs Frequency Output	U-D OSC-1	TUNING Generator
Sine Generator - 5 Hz to 5 kHz 5 mV to 5V rms variable	U-D OSC-1 (#2) HP Model 204D	SIGNAL Generator
AC Voltmeter Oscilloscope	HP Model 400EL HP Model 1202B	Monitor Signal Amplitudes And Waveshapes
DC Monitor	HP Model 7035B (plotter) Keithley Mod 168 (Auto DVM)	Measure LOG DC Output
Ratio Transformer (Optional)	Singer RT-20R	Varies signal precisely without changing oscillator input

TABLE 6.1 INSTRUMENTS

FROM	TO
TUNING gen. (AC out)	X AXIS Oscilloscope TF11 TUNING input
TUNING gen. (lin DC vs freq)	TF11 LIN DC input (not req'd for TF-11L)
SIGNAL gen. (AC out)	TF11 INPUT
AC voltmeter	Oscilloscope Y-AXIS
Oscilloscope Y AXIS	Point Monitored
DC Monitor	TF11 LOG DC output

TABLE 6.2 CONNECTIONS

The optional ratio transformer can be used between the SIGNAL generator and the TF11 input to provide a precisely set AC voltage without having to continually change the SIGNAL generator output.

6.2 OUTPUT ZERO (covers on)

Provide: SIGNAL input - zero (signal source connected or input shorted)
TUNING input - 500 Hz ≈ 1V rms
F.S. RANGE - 300g

Monitor: OUTPUT

Adjust front-panel ZERO potentiometers for minimum output. Refer to Fig. 6.1 for proper adjustment. If ZERO adjustment cannot be made from front panel, refer to Section 6.7.

6.3 OUTPUT ENVELOPE (covers on)

Provide: SIGNAL input - 502 Hz, 1.00 V rms
TUNING input - 500 Hz, ≈ 1 V rms
300 g range; HI-LIMIT bandwidth (CW)

Monitor: TF-11 output

Average output should be 1.00 V ±1% and variation of gain as Lisajous pattern rolls over and over should be within ±1.5%. Refer to Fig. 6.2 for typical output patterns and corrective adjustments if any.

Decreasing F.S. RANGE to 30 g should cause OVERLOAD indicator to flash.

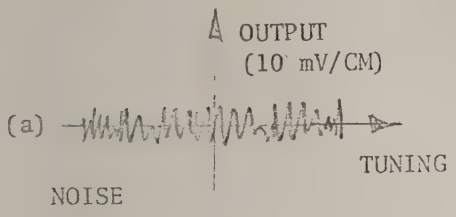
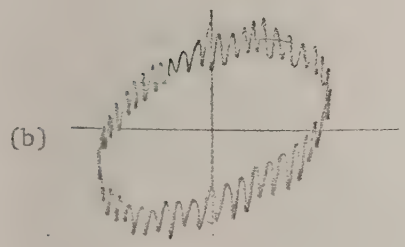
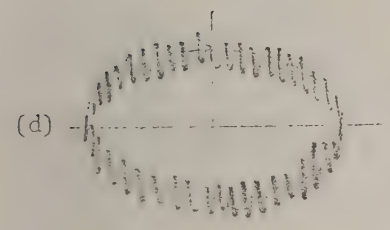
LISAJOUS PATTERN	COMMENTS	REMEDY
	Zero properly adjusted	None needed
	CO & QUAD ZERO not properly adjusted	Adjust both front panel ZERO potentiometers
	CO ZERO not properly adjusted	Adjust upper front panel ZERO potentiometer
	QUAD ZERO not properly adjusted	Adjust lower front panel ZERO potentiometer
	OUTPUT COMP. not properly adjusted	Remove top cover Refer to Section 6.7

FIG. 6.1 OUTPUT ZERO ADJUSTMENT LISAJOUS PATTERNS
ZERO SIGNAL INPUT - 300g F.S. RANGE

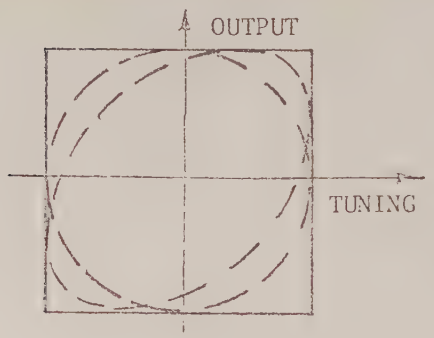
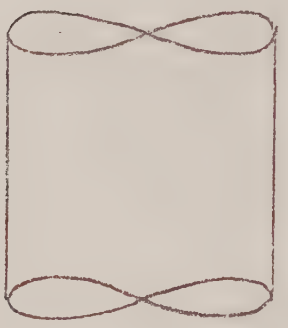
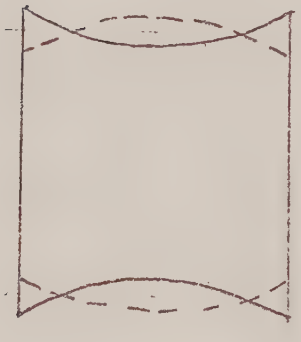
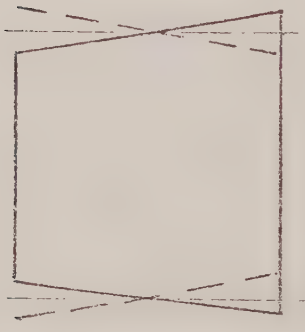
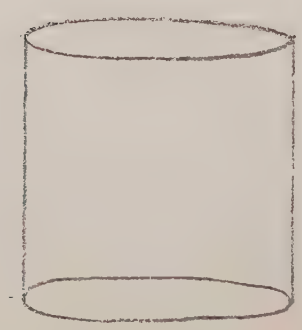
MODULATION ENVELOPE	COMMENTS	REMEDY
(a) 	Output properly adjusted Av. gain = 1.0 ±1% Gain Δ < ±1.5%	None needed
(b) 	Phase not correctly adjusted. Gain variation with phase noted in 6.3.	Adjust PHASE through top cover to minimize gain variation
(c) 	Gain Balance not correctly adjusted. Gain variation with phase noted in 6.3.	Adjust GAIN BALANCE through top cover to minimize gain variation. Adjust GAIN to re-establish unity gain.
(d) 	CO Flatness not correctly adjusted. Does not cause gain variation with phase	Remove top cover. Refer to Fig. 6.3. Adjust FLATNESS on D-C Card.
(e) 	QUAD Flatness not correctly adjusted. Does not cause gain variation with phase. Should gain variation be noticed, check ZERO (section 6.2)	Remove top cover. Refer to Fig. 6.3. Adjust FLATNESS on D-Q Card.

FIG. 6.2 OUTPUT ENVELOPE LISAJOUS PATTERNS WITH CORRECTIVE ACTION

Should average output fall outside 1.00V ±1%, readjust GAIN through top cover. Should GAIN adjustment through top cover be inadequate, refer to Section 6.10.

Failure to provide a rectangular output modulation envelope as in Fig. 6.2 (a), but one that pulses or looks like a "bow tie" indicates that either the CO or the QUAD modulator card (D-C or D-Q) may be faulty. Proceed to Section 6.13.

Excessive phase error patterns, even at very small frequency differences, indicates a problem on the FILTER CARD F. Proceed to Sections 6.11, 6.12 and 6.13.

6.4 FREQUENCY RESPONSE (covers on)

Provide: SIGNAL input - 1.00 V rms
TUNING input - ∿ 1 V rms
HI LIMIT (where requested) - CW (200 Hz)
LO LIMIT (where requested) - CCW (2 Hz)
F.S. RANGE - 300 g

TUNING (Hz)	SIGNAL (Hz)	AVERAGE OUTPUT (rms)	GAIN VARIATION	BANDWIDTH
5000	5002 - 5005	1.00 V ±3%	±3%	HI-LIMIT
50	50.1 - 50.2	1.00 V ±3%	±1.5%	LO-LIMIT
5	5.1 - 5.2	1.00 V ±3%	±3%	LO-LIMIT

The small differences in SIGNAL frequency and TUNING frequency that are required can be obtained by varying one or the other until the Lisajous pattern rolls over and over at the approximately required difference frequency.

Should excessive gain variation with phase occur at the extremes of the frequency band refer to Sections 6.11 and 6.12.

6.5 FILTER BANDWIDTH (covers on)

Provide: SIGNAL input - 600 Hz 1.00 V rms
TUNING input - 500 Hz ≈ 1 V rms
F.S. RANGE - 300 g
HI-LIMIT - CW (200 Hz)

Monitor: Output

The measured value of output should be approximately 0.6 - 0.8 V rms. The modulation envelope may be slightly distorted, as in Fig. 6.2 (b) and (c). This is acceptable, as it is impossible to match the filter skirts of the CO and QUAD channels exactly with EVR's.

Provide: SIGNAL input 51.0 Hz 1 V rms
TUNING input 50.0 Hz ∿ 1V rms
300 g F.S.
LO-LIMIT BW CCW - (2 Hz)

Monitor: OUTPUT on Y Axis (TUNING ON X-Axis)

The measured average value of the output should again be 0.6 to 0.8 V rms and some distortion on the modulation envelope is acceptable.

If replacement of EVR(s) is needed, a matched set must be supplied for Card F, although a single failed EVR may often be replaced by changing the EVR's around in the circuit, and performing the checks above.

6.6 LOG DC (covers on)

Provide: Check ZERO balance
SIGNAL input - 22.4 mV rms 505 Hz
TUNING input - ∿ 1V rms 500 Hz
HI-LIMIT CW (200 Hz)

Monitor: LOG DC output

The following values of LOG DC output should be noted as function of F.S. RANGE

F.S. RANGE (g)	3	10	30	100	300	TOLERANCE
LOG DC (1V/decade)	0	-.500V	-1.00V	-1.50V	-2.00V	±13 mV
LOG DC (60 mV/decade)	0 mV	-30 mV	-60 mV	-90 mV	-120 mV	±1 mV

Should any of the reading be out of tolerance, remove the top cover and refer to Section 6.16.

****

The following sections are used only to pinpoint malfunctions or to correct for out-of-tolerance performance. The adjustments are made at the factory and normally do not have to be done again. Remove the covers before proceeding and refer to Fig. 6.3 for the location of various adjustments and circuit boards. THE FOLLOWING SECTIONS ARE NOT PART OF THE NORMAL CALIBRATION PROCEDURE.

****

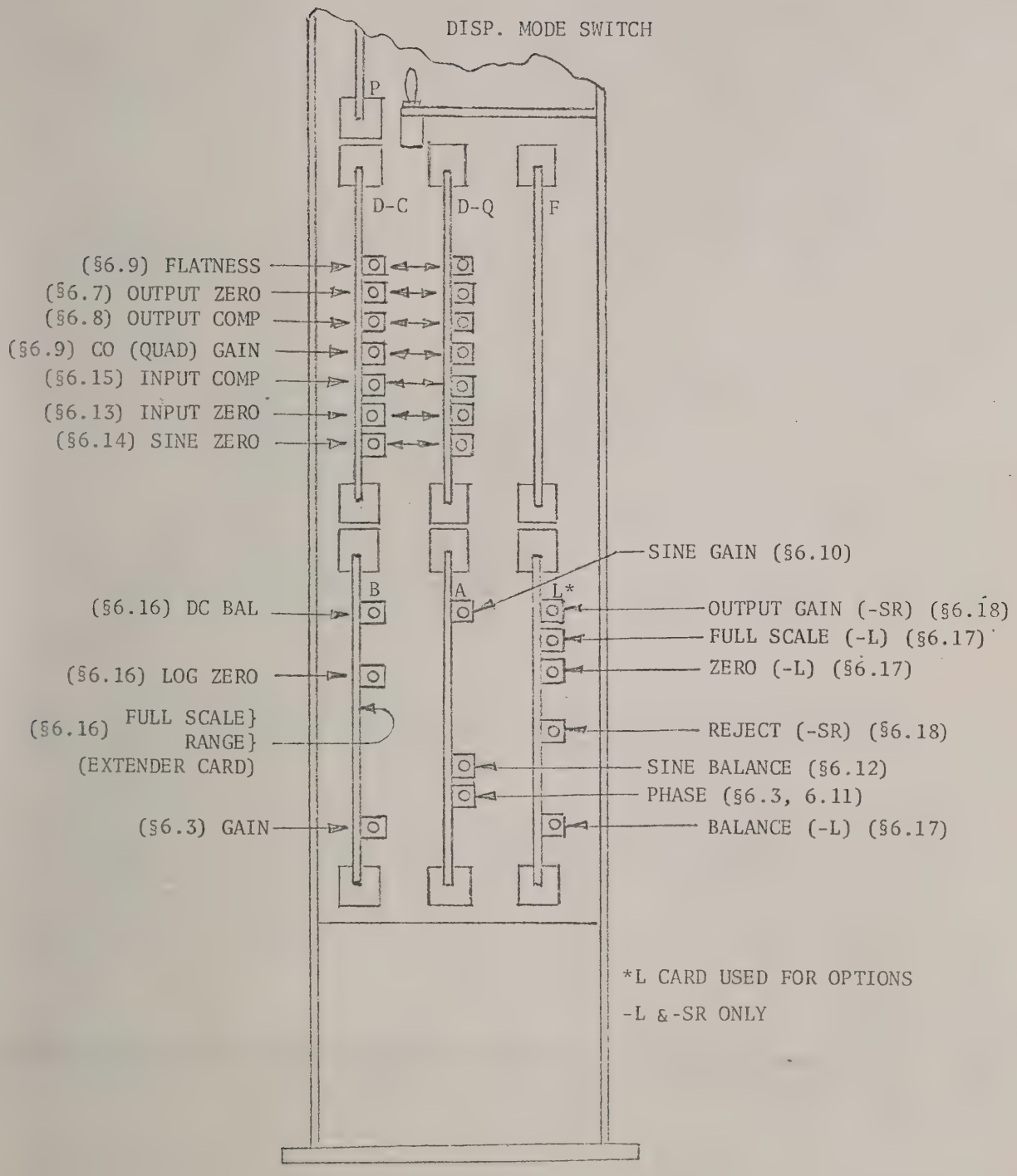


FIG. 6.3

TOP VIEW OF TF-11 WITH COVER REMOVED

ADJUSTMENT LOCATIONS SHOWN

AND SECTION REFERENCES

6.7 OUTPUT ZERO (Cards D-C and D-Q)

Should adjustment be impossible to make from the front panel, turn both front panel pots full CCW and then turn both ten turns CW. With the same setup as in Section 6.2 adjust the OUTPUT ZERO potentiometers on the D-C and D-Q cards for minimum output.

Should the OUTPUT ZERO adjustment be particularly unstable or the internal potentiometer adjustment is insufficient, check to see that the heaters are working on the multipliers mounted on the D-C and D-Q cards under the sponge insulators. Consult factory if the trouble is not apparent.

6.8 OUTPUT COMPENSATION (Cards D-C and C-Q)

With the conditions the same as in 6.2, excessive curvature in the ZERO output Lisajous pattern (second harmonic output) as in Figure 6.1 (e) requires correction by adjusting the OUTPUT COMP. potentiometer on either the D-C or D-Q card.

6.9 FLATNESS, GAIN BALANCE (Cards D-C & D-Q)

Refer to Fig. 6.2 and Section 6.3 for test conditions. Either CO or the QUAD GAIN potentiometer may be used to adjust the GAIN BALANCE needed in Fig. 6.2 (c).

6.10 SINE GAIN (Card A)

If the GAIN adjustment in Section 6.3 is insufficient to establish unity gain, set GAIN potentiometer (Card B) to middle range and adjust SINE GAIN for unity gain as in Section 6.3.

Monitor voltage at TP-1 (see Component Layout Card A). The value is not critical, but should generally be 5V rms ±10%. The value should be constant as the TUNING input is varied from .3 to 3V rms after AGC action has occurred.

Adjustment of the SINE GAIN may require readjustment of the SINE BALANCE in Section 6.12.

6.11 PHASE (Card A)

Perform the following if excessive gain variation with phase occurs at 5 Hz or 5 kHz after the PHASE adjustment has been properly made at 500 Hz as described in Section 6.3 and Fig. 6.2 (b).

Monitor TUNING or TP-1 on X-Axis
TP-3 on Y-Axis

Switch tuning frequency successively from 5 to 50 to 500 and finally to 5000 Hz. The amplitude at TP-3 should remain at 5V rms ±10% and the Lisajous pattern should show the circle typical of 90° phase at each frequency after the APC takes a fraction of a second to correct after each frequency switching.

If 90° phase cannot be maintained at all frequencies, proceed to 6.12, but do not readjust the PHASE potentiometer.

6.12 SINE BALANCE (Card A)

Monitor: TUNING on X-Axis
TP-2 on Y-Axis

Switch TUNING frequency successively from 5 to 50 to 500 to 5000 Hz. The proper shape of the Lisajous pattern is shown in Fig. 6.4 after APC correction.

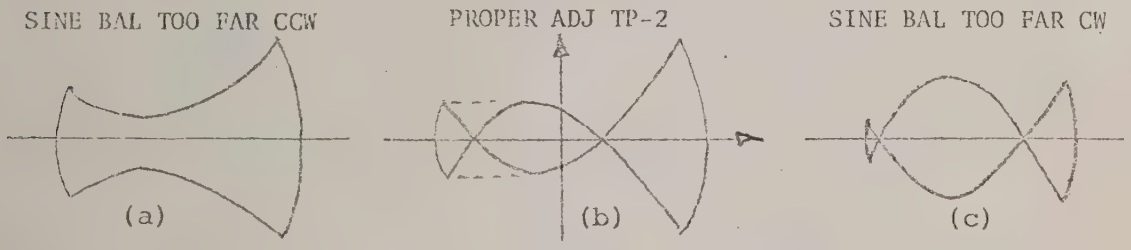


FIG. 6.4 BALANCE OF PHASE DETECTOR-LISAJOUS PATTERNS

A little rounding of the sharp corners of the pattern is to be expected at 5 kHz. Adjust SINE BALANCE for the equal lobes as shown in Fig. 6.4 (b). Readjust PHASE as in Section 6.3.

If 90° phase cannot be maintained in 6.11 and 6.12, replacement of V2 (light-controlled resistor) may be attempted as a solution. A factory-supplied low-distortion unit is necessary here.

6.13 INPUT ZERO (Cards D-C & D-Q)

Provide: Zero SIGNAL input
TUNING signal - 500 Hz 1V rms

Monitor: TP-C (Card F)

Adjust INPUT ZERO (Card D-C) for minimum first harmonic signal

Monitor: TP-Q (Card F)

Adjust INPUT ZERO (CARD D-Q) for minimum first harmonic signal. Refer to FIG. 6.5 for proper modulation envelope with SIGNAL input = 1.00V rms (300g range) 505 Hz.

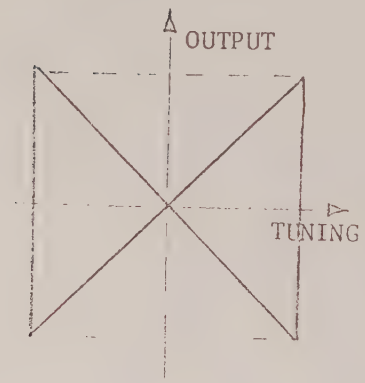
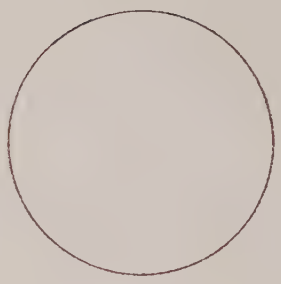
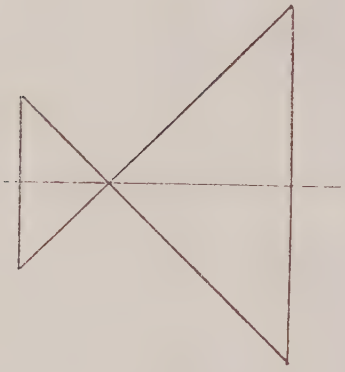
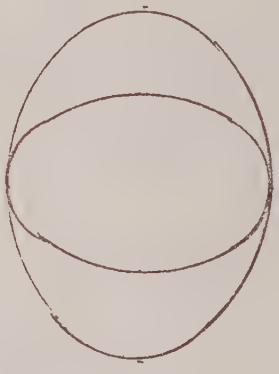
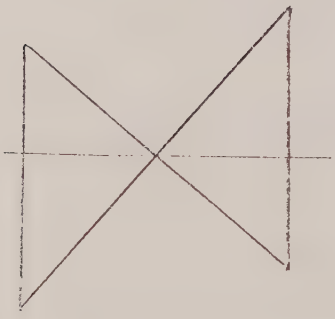
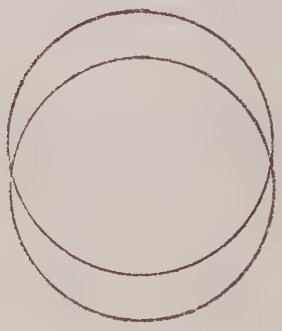
CO OUTPUT (TP-C)	QUAD OUTPUT (TP-Q)	COMMENTS
		Properly Adjusted Equal Lobes
		SINE ZERO improperly adjusted. See section 6.
		INPUT ZERO improperly adjusted. See section 6.12.

FIG. 6.5

LISAJOUS PATTERNS

MODULATOR OUTPUT ENVELOPES

If proper signal pattern is absent, replace multiplier Z2 on appropriate card.

6.14 SINE ZERO (Cards D-C & D-Q)

Provide: SIGNAL input - 505 Hz 1V rms
TUNING input - 500 Hz ∿ 1V rms
300g F.S. RANGE

Monitor: TP-C and TP-Q (Card F)

Refer to Fig. 6.5 and adjust SINE ZERO on TP-C and TP-Q to establish equal lobes on modulation envelope.

Any readjustment in Sections 6.13 and 6.14 requires a re-examination of the OUTPUT envelope as in Section 6.3.

6.15 INPUT COMPENSATION (Cards D-C & D-Q)

This adjustment has little effect and need not be readjusted.

6.16 LOG DC (Board B) (7)

Provide: SIGNAL input - 22.4 mV rms, 505 Hz
TUNING input - 1V rms, 500 Hz
HI-LIMIT - CW (200 Hz)

(Make sure ZERO output adjustment is accurately done)

Monitor TP-2 (Card B) with oscilloscope. Adjust DC BAL (CARD B) until peak value of half-wave rectified shape on 300g F.S. RANGE is 1% (∿30 mV pk) of peak value on 3 g F.S. RANGE (∿3V pk).

Then monitor LOG DC output.

On: 3g RANGE adjust FULL SCALE for 0V output (±13 mV)
30g RANGE adjust RANGE for -1.000 VDC output
300g RANGE adjust LOG ZERO for -2.000 VDC output

Repeat above steps until correct readings are obtained (see table in Section 6.5). An extender card is required.

6.17 LIN DC GENERATOR (Card L - L Option only)

Monitor and make adjustments in Table below.

TUNING freq (Hz)	MONITOR	ADJUST Potentiometer	MEASURE
20	TP-1 Card L	BAL	equal half sine waves
2,000 Hz	LIN-DC out	FULL SCALE	4V DC
20	LIN-DC out	ZERO	40 mV DC

6.18 SINE REJECT (Card L - SR Option only)

Provide: TUNING input - 500 Hz 1V rms
SIGNAL input - 550 Hz 1V rms
BW to LO LIMIT (CCW - 2 Hz)

Monitor: SINE REJECT output

Adjust: OUTPUT GAIN pot (Card L) for unity gain (out-of-band signal)

Then put BW to HI-LIMIT (CW-200 Hz), SIGNAL input to 500.5 Hz ($\Delta f \simeq .5$ Hz.)

Adjust: REJECT pot. (Card L) for minimum output (in band signal).

7. REPLACEMENT PARTS

7.1 General

Whenever possible standard electronic components have been used in this instrument. Most standard components can be purchased locally. Difficult to find components and special components are listed in Section 7.2; however, common components such as carbon composition resistors (10%) carbon film resistors (1%), and most capacitors are not called out in this replacement parts list. When ordering replacement parts or subassemblies from Unholtz-Dickie Corporation, please always include:

a) complete description of item ordered
b) schematic reference number, if assigned
c) description of assembly in which part is used
d) model and serial number of instrument

Alternate Parts may be substituted in some cases where availability and pricing warrant. In particular in the case of semiconductors several manufacturers may make almost identical items or identical items under different part numbers. Section 7.3 lists some of the alternate parts that may be found in a particular instrument.

7.2 Replacement Parts List

7.2.1 Chassis Assembly

FRONT PANEL MOUNTED PARTS

SOURCE	PART NO	DESCRIPTION	QTY
U-D CORP	ASM-1033A	5 Pole 5 pos. rotary switch	1
U-D CORP	ASM-1033A	2 Pole 3 pos. rotary switch	1
C & K	7301 KBE	3PDT Toggle Switch	1
BOURNS	A3059J-1-103M	25 turn screwdriver potentiometer 10K	4
KINGS	UC79-45	BNC Connector	2
GENERAL ILLUMINATION	4000-2	LED indicator	3

BACK PANEL MOUNTED PARTS

SOURCE	PART NO.	DESCRIPTION	QTY
U-D CORP		(line cord)	
CINCH	P-303-LAB	line voltage	1
CINCH	S-303-CCT	(mating connector)	
BUSSMAN	HWA-AF	Fuse Holder	1
BUSSMAN	GMW 1/2	Fuse ½A	1
ALCO	MSS-22	DPST Slide Switch	1
KINGS	KC79-35	BNC Connector	5
CANNON	DBC-25S	25 Pin "D" Connector	1
CANNON	DBC-35P	(mating connector)	

CHASSIS MOUNTED PARTS

U-D CORP	T-79	Transformer	1
P & B	E10-Z4-J1.OK	Relay	2
AMPHENOL	143-022-01-100	PC Connector	6
AMPHENOL	143-018-01-100	PC Connector	1
SPRAGUE	TVL 1220	500 F/25V Capacitor	2
ALCO	MST-115D	SPDT Switch	1

7.2.2 Plug-in Subassemblies

	Card A-TF11	Auto Gain Control	
BARNES	821-20011-144	IC Socket 14 pin	2
BARNES	831-55022-084	IC Socket 8 pin	1
INDUSTRIAL ELECTRONIC HARDWARE	MPT 6005-1	Transistor socket 5 pin	2
FAIRCHILD	uA 747	Dual Op-AMP	2
RCA	CA3080	OP-AMP	1
VAC-TECH	VTL2C2	Electrically variable Resistor (EVR)	2
SYLVANIA	IN914	Diode	4
BECKMAN	89WR10K	Trimmer Pot 10K	2
BECKMAN	89WR50K	Trimmer Pot 50K	1

CARD B-TF11 BUFFER AND METER

SOURCE	PART NO.	DESCRIPTION	QTY
BARNES	821-20011-144	IC Socket 14 pin	4
BARNES	831-55022-104	IC Socket 10 pin	1
INDUSTRIAL ELECTRONIC HARDWARE	MPT 6003	Transistor Socket 3 pin	1
FAIRCHILD	µA 747	Dual Op-AMP	4
FAIRCHILD	µA 726	Dual Heated Transistor	1
TI	2N 699	NPN Transistor	1
SYLVANIA	IN 914	Diode	5
BECKMAN	89 WR200	Trimmer Pot 200Ω	2
BECKMAN	89 WR10K	Trimmer Pot 10K	2

CARD D-TF11 MODULATOR

BARNES	821-20011-144	IC Socket 14 pin	1
BARNES	821-20011-164	IC Socket 16 pin	2
FAIRCHILD	µA 747	Dual Op-AMP	1
MOTOROLA	MC1494	Multiplier	2
BECKMAN	89 WR 10K	Trimmer Pot 10K	1
BECKMAN	89 WR 20K	Trimmer Pot 20K	4
BECKMAN	89 WR 50K	Trimmer Pot 50K	2
U-D	175Q14111	Thermistor	2
U-D	A12031	Thermal Boot	2

CARD F-TF11 FILTER

BARNES	821-20011-144	IC Socket 14 pin	2
IND ELECTR HARDWARE	MPT 6005-1	Transistor Socket 5 pin	7
IND ELECTR HARDWARE	MPT 6003	Transistor Socket 3 pin	3
FAIRCHILD	µA 747	Dual OP-AMP	2
VAC-TECH	(VTL-2C2)	Set of 7 selected VTL 2C2 Electrically Variable Resistor (EVR)	1

CARD F-TF11 FILTER (cont'd)

SOURCE	PART NO.	DESCRIPTION	QTY
FAIRCHILD	2N 699	NPN Transistor	2
TI	2N 4998	PNP Transistor	1
INTERSIL	IH-8007	FET-OP-AMP	2
SYLVANIA	IN 914	Diode	3
	CARD L-TF11 LIN DC GENERATOR (Optional)		
BARNES	821-20011-144	1C Socket 14 pin	2
FAIRCHILD	MA 747	Dual OP-AMP	2
SYLVANIA	IN 914	Diode	2
BECKMAN	89WR10K	Trimmer Pot 10K	3
	CARD P-TF11 POWER SUPPLY		
BARNES	821-20011-144	IC Socket 14 pin	2
IND. ELEC. HARDWARE	MPT 6003	Transistor Socket	1
FAIRCHILD	µA 723	Power Supply Regulator	2
FAIRCHILD	2N 4889	PNP Transistor	1
RCA	40389	NPN Power Transistor	1
RCA	40410	PNP Power Transistor	1
WESTINGHOUSE	IN5353	Rectifier Diode 300V	4

7.3 Alternate Parts

Due to availability and pricing some parts, in particular semiconductors, of a different manufacture and different part numbers may be substituted. The following is a list of some of the alternate parts that may be used. The first part listed in each group is the part originally used by Unholtz-Dickie, which is not necessarily the first introduced part. Parts marked with an asterisk (*) are not a direct replacement, but may be substituted in this instrument.

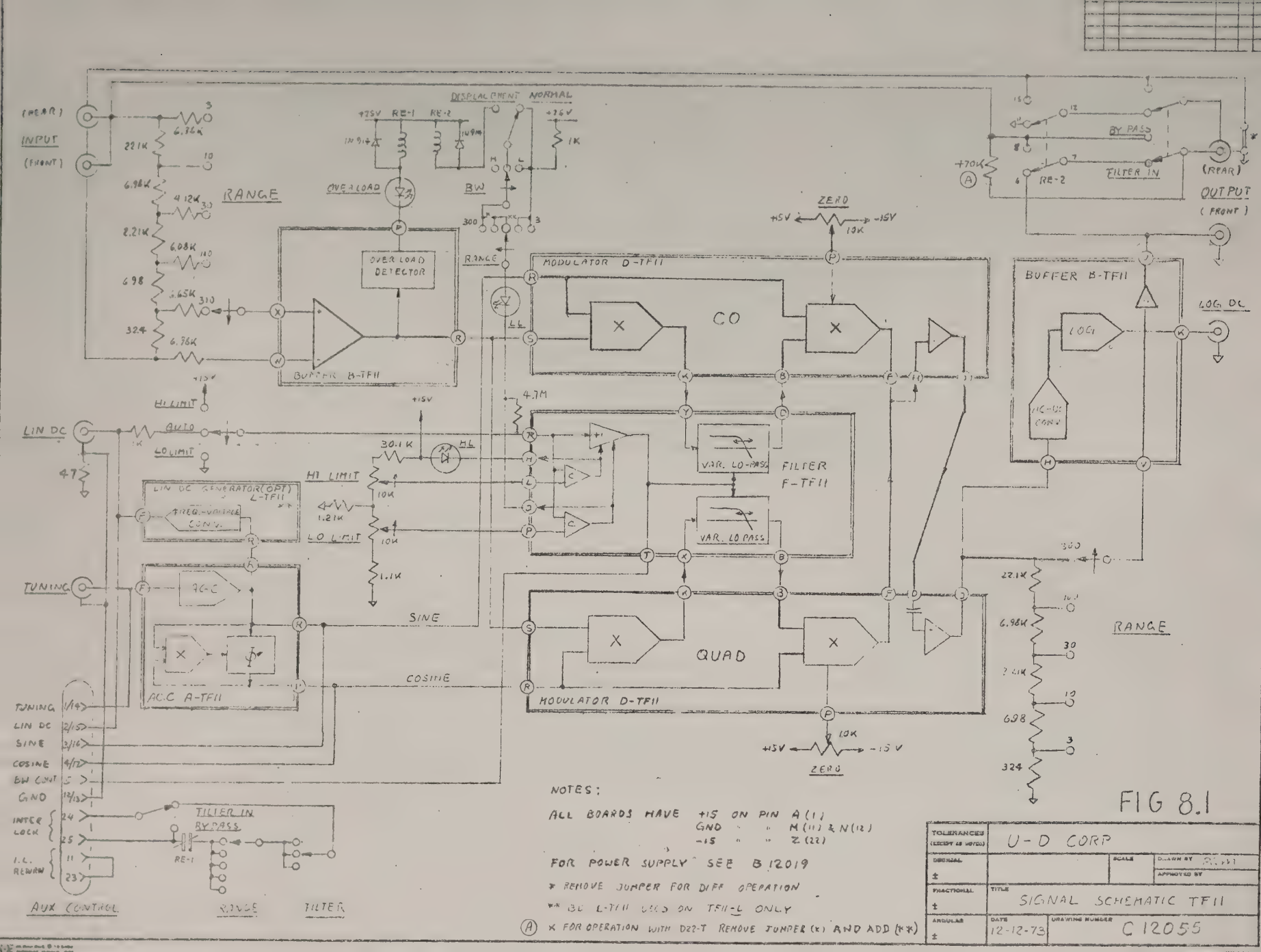
7.3.1 FET-OP-Amp

SOURCE	PART NO.
INTERSIL	ICL8007C
SIGNETICS	NE 536 T
FAIRCHILD	µA 740 (*)
ANALOG DEVICES	AD-540
TELEDYNE	1421

8. SCHEMATICS AND LAYOUT DIAGRAMS

S.N. 395, 396, 397

FIG.	TITLE	DWG. NO.	REV.
8-1	SIGNAL SCHEMATIC MODEL TF11	C12055	A
8-2	AUTO GAIN CONTROL SCHEM. A-TF11	B12051	C
8-3	COMPONENT LAYOUT A-TF11	A12052	C
8-4	I/O BUFFER SCHEM B-TF11	B12064	A
8-5	COMPONENT LAYOUT B-TF11	A12065	A
8-6	MODULATOR SCHEM. D-TF11	B12066	NC
8-7	COMPONENT LAYOUT D-TF11	A12067	NC
8-8	FILTER SCHEM. F-TF11	B12017	F
8-9	COMPONENT LAYOUT F-TF11	A12043	C
8-10	POWER SUPPLY SCHEM P-TF11	B12019 •	A
8-11	COMPONENT LAYOUT P-TF11	A12029	NC
~~8-12~~	~~LIN DC GEN. SCHEM. L-TF11~~	A12048	A NA
~~8-13~~	~~COMPONENT LAYOUT L-TF11~~	A12028	B NA



NOTES:

ALL BOARDS HAVE +15 ON PIN A(1)
GND " " M(11) & N(12)
-15 " " Z(22)

FOR POWER SUPPLY SEE B 12019

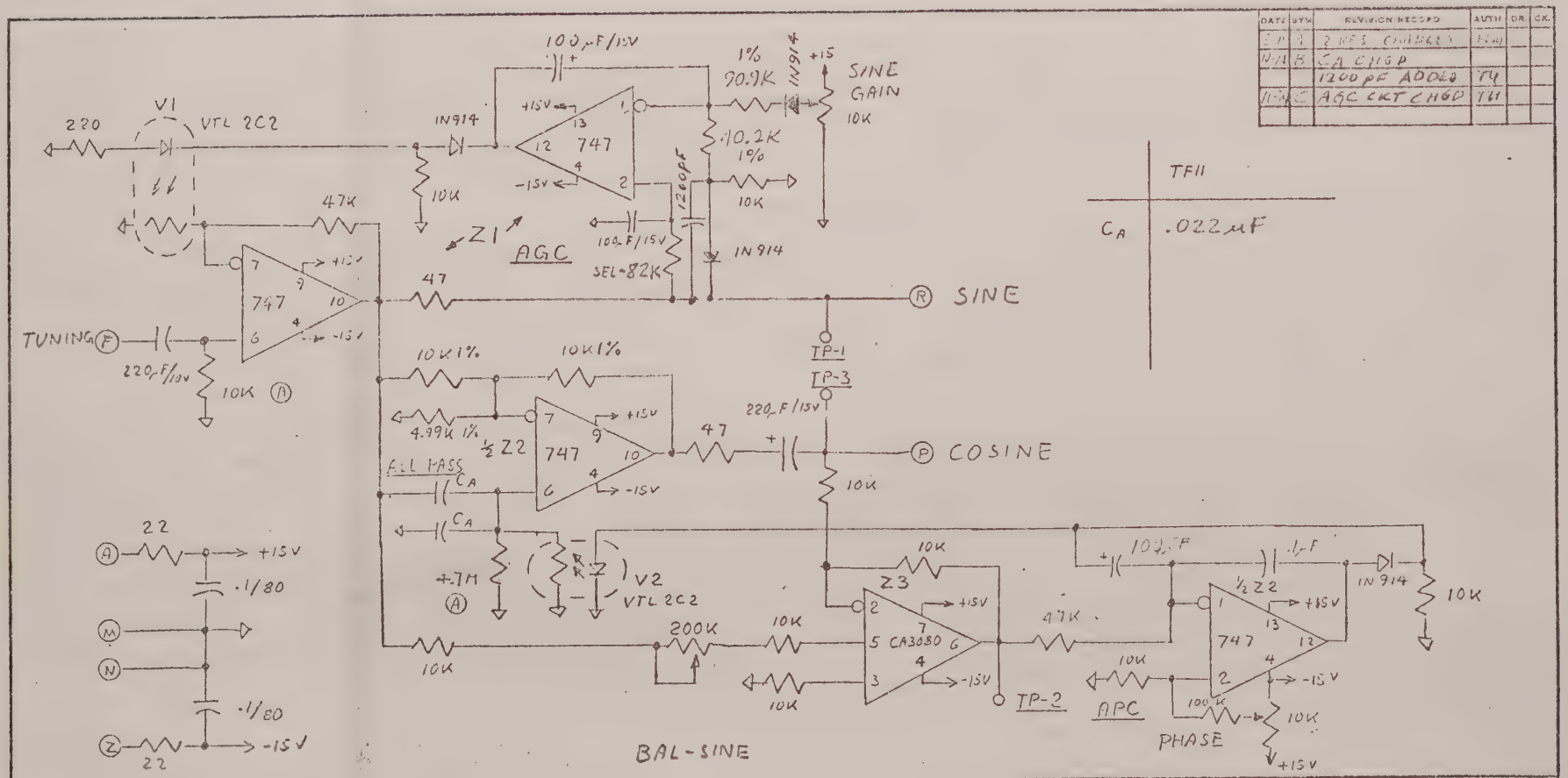
* REMOVE JUMPER FOR DIFF OPERATION

** BE L-TFII USED ON TFII-L ONLY

(A) X FOR OPERATION WITH D22-T REMOVE JUMPER (X) AND ADD (**)

FIG 8.1

TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE	DRAWN BY R.F.H. APPROVED BY
FRACTIONAL ±	TITLE SIGNAL SCHEMATIC TFII		
ANGULAR ±	DATE 12-12-73	DRAWING NUMBER C 12055	



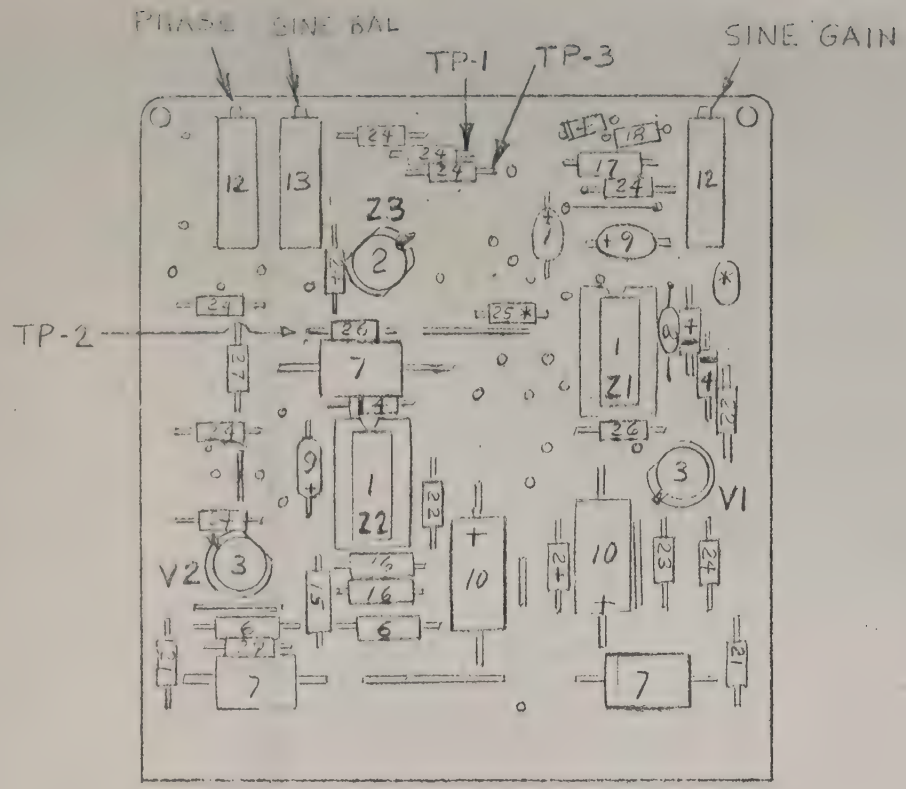
DATE	BY	REVISION RECORD	AUTH	DR.	CK.
9-11	A	2 RES CHANGED	MH		
10-1	B	CA CHGD			
		1200 pF ADDED	TH		
10-10	C	AGC CKT CHGD	TH		

	TFII
C_A	.022μF

TOLERANCES (EXCEPT AS NOTED)	V-D CORP
DECIMAL ±	SCALE
	DRAWN BY P.L. W.
	APPROVED BY
FRACTIONAL ±	TITLE AUTO GAIN & PHASE CONTOL A-TFII
ANGULAR ±	DATE 10-10-73
	DRAWING NUMBER B 12051

FIG 8.2

K-E ALBANENE © 10 6488



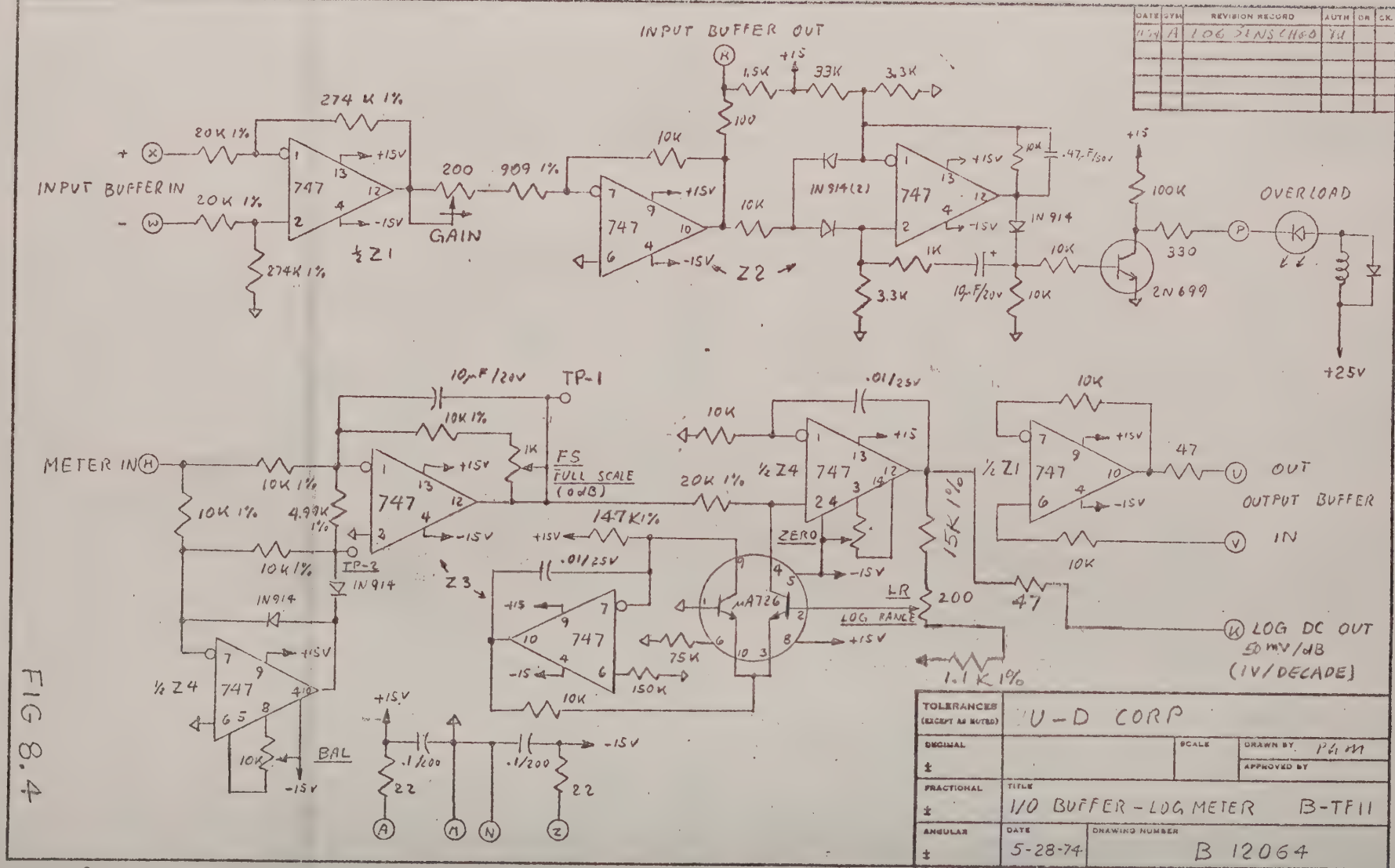
DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
[illegible]	A	[illegible]			
10-14	B	#6 CHGD #7 ADDED	TH		
11-14	C	AGC CKT CHGD	TH		

ITEM	QTY	COMP		ITEM	QTY	COMP	
1	2	A 747		21	2	22 Ω	10%
2	1	CA3080		22	2	47 Ω	¼W
3	2	VIL 252		23	1	220 Ω	
4	4	IN914		24	10	10 K	
5				25	1	82K	
6	2	.022/200V		26	2	47K	
7	3	.1 μF/80V		27	1	100K	10%
8	1	1200 pF		28			
9	3	100 μF/15V		29	1	4.7M	
10	2	220 μF/10V					
11							
12	2	10K POT					
13	1	200K POT					
14							
15	1	4.99K	1%				
16	2	10.0K					
17	1	40.2K					
18	1	90.9K					
19							
20				*		SELECTED	

TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE FULL	DRAWN BY PGM APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT A-TF11 AUTO GAIN & PHASE CONTROL		
ANGULAR ±	DATE 11-9-73	DRAWING NUMBER A12052	

FIG 8.3

K&E ALBANENE ® 10 5465 ENGINEERS' STANDARD FORM
MADE IN U.S.A. 28299

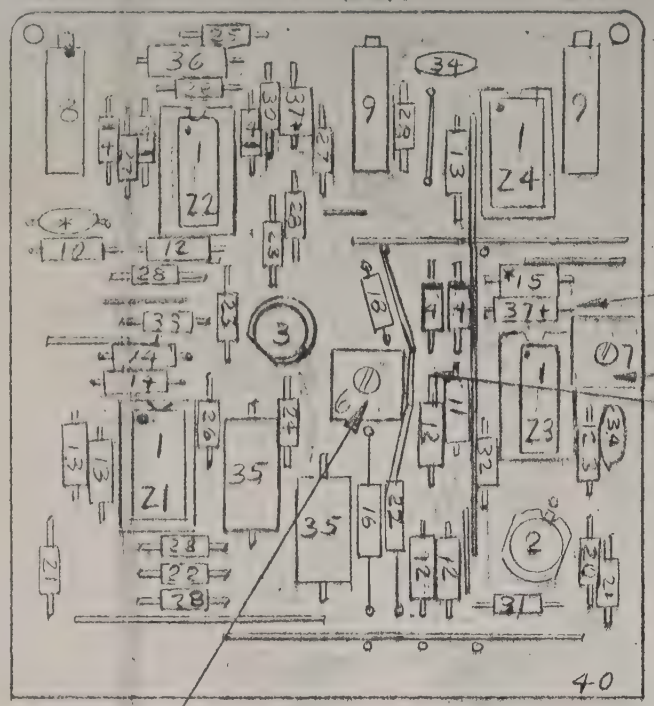


DATE	GYM	REVISION RECORD	AUTH	DR	CK
11-74	A	LOG ZENSCH80	TH		

TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE	DRAWN BY PGM
			APPROVED BY
FRACTIONAL ±	TITLE I/O BUFFER - LOG METER		B-TF11
ANGULAR ±	DATE 5-28-74	DRAWING NUMBER B 12064	

FIG 8.4

DATE	SYM	REVISION RECORD	APP'D	DR.	CK.
11-74	A	LOG SENS C116D	TU.		



* SELECTED AT TEST

ITEM	QTY	COMP	ITEM	QTY	COMP
1	4	μA747	21	2	22Ω
2	1	μA726	22	2	47Ω
3	1	2N699	23	1	100Ω
4	5	IN914	24	1	330Ω
5			25	2	1K
6	1	200Ω POT	26	1	1.5K
7	1	1K POT	27	2	3.3K
8	1	200Ω POT	28	8	10K
9	2	10K POT	29		
10	1	909Ω	30	1	33K
11	1	4.99K	31	1	75K
12	4	10K	32	1	150K
13	3	20K	33	1	100K
14	2	274K			
15	1	953K	34	2	.01μF/25V
16	1	1.1K	35	2	.1 μF/80V
17			36	1	.47μF/50V
18	1	15K	37	2	10μF/12V
19	1	23.7K			
20	1	147K	40		12006-C

1% 1/8 W

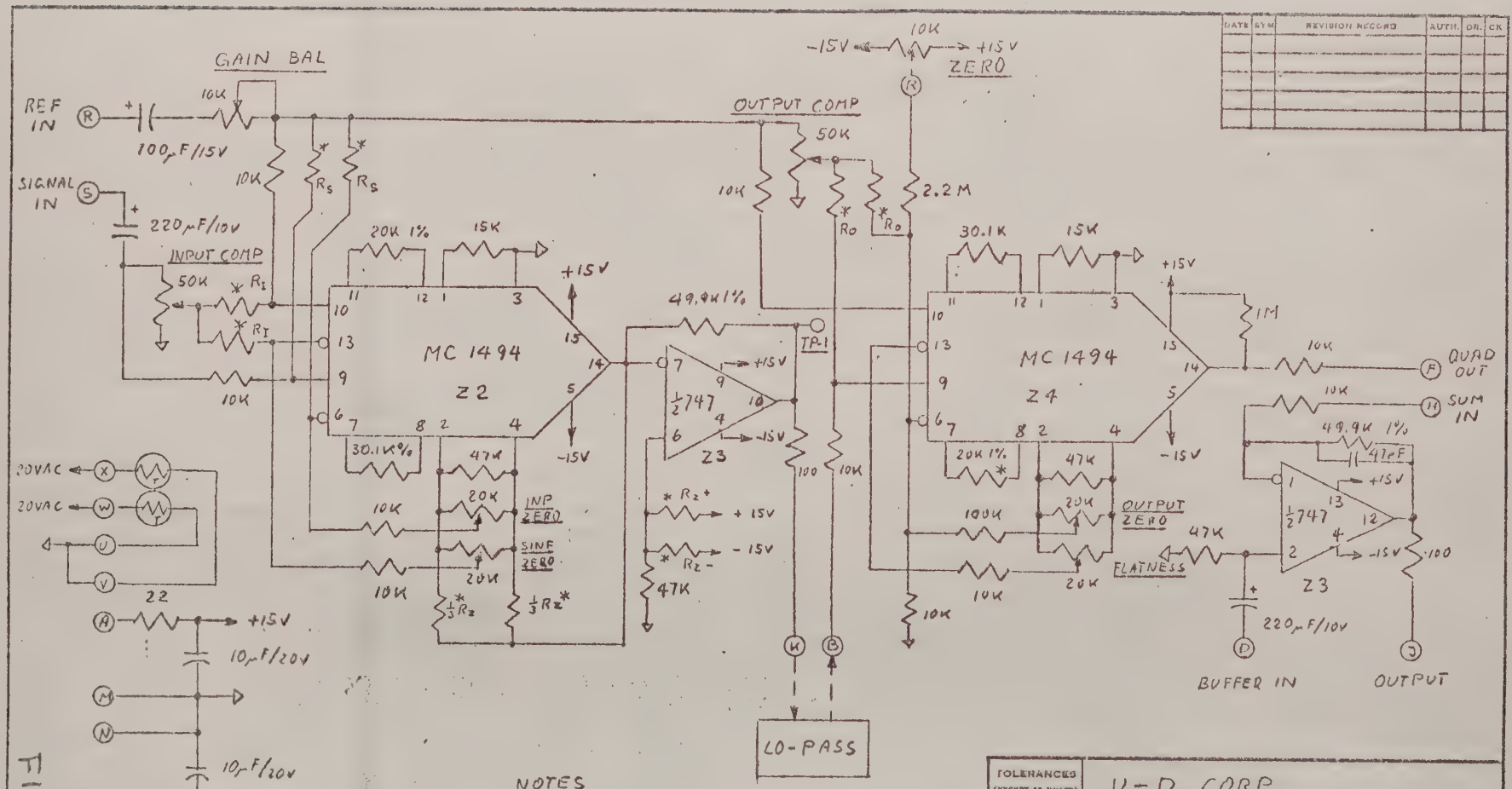
10% 1/4 W

TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE FULL	DRAWN BY PGM
			APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT B-TF11 BUFFER & LOG METER		
ANGULAR ±	DATE 5-28-74	DRAWING NUMBER A12065	

FIG 8.5

K+E ALBANENE ® 10 8465 ENGINEERS' STANDARD FORM

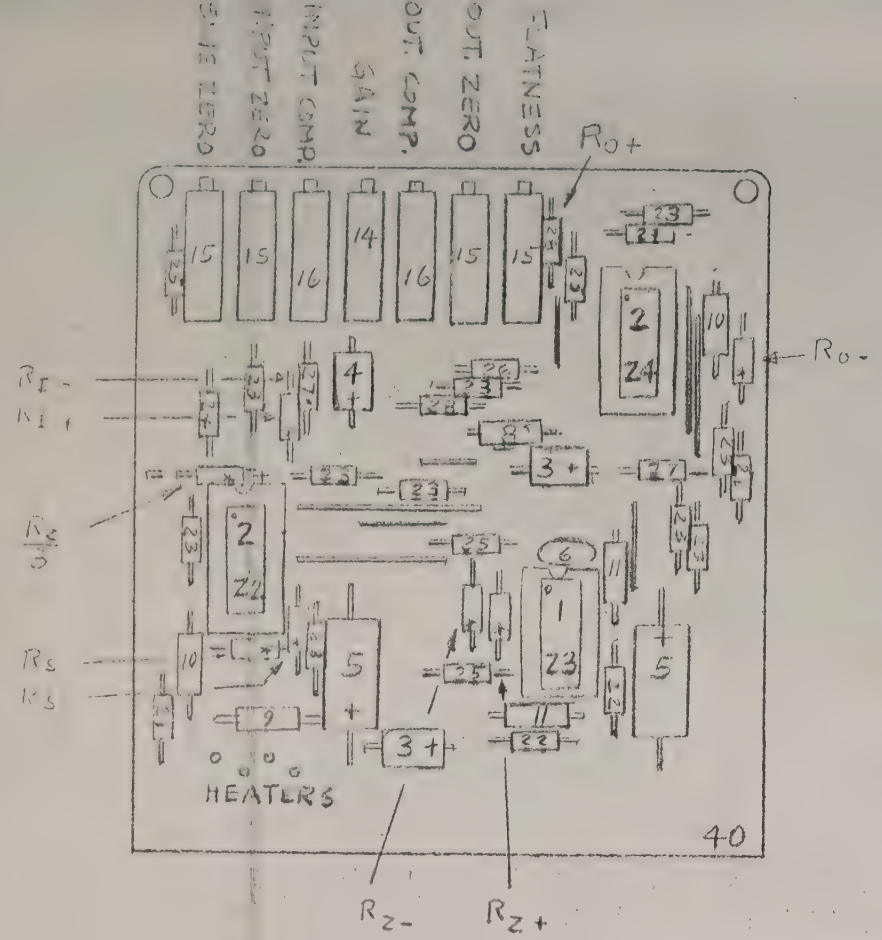
MADE IN U.S.A.



DATE	BY	REVISION RECORD	AUTH.	OR.	CK

TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE	DRAWN BY PL M
			APPROVED BY
FRACTIONAL ±	TITLE MODULATOR D-TF11		
ANGULAR ±	DATE 5-28-74	DRAWING NUMBER B 12066	

FIG. 8.9



DATE	SYM	REVISION RECORD	AUTH.	BY	CK.

ITEM	QTY	COMP
1	1	μA 747
2	2	NE 1494
3	2	10μF / 20V
4	1	100μF / 15V
5	2	220μF / 10V
6	1	50pF
7		
8	1	23.7K
9	1	20.0K
10	2	30.1K
11	2	49.9K
12		
13		
14	1	10K POT
15	4	20K POT
16	2	50K POT
17		
18		
19		
20		

ITEM	QTY	COMP
21	2	22Ω
22	2	100Ω
23	10	10K
24	2	15K
25	4	47K
26	1	100K
27	2	1M
28	2	2.2M
*		SELECTED
40		12004-D

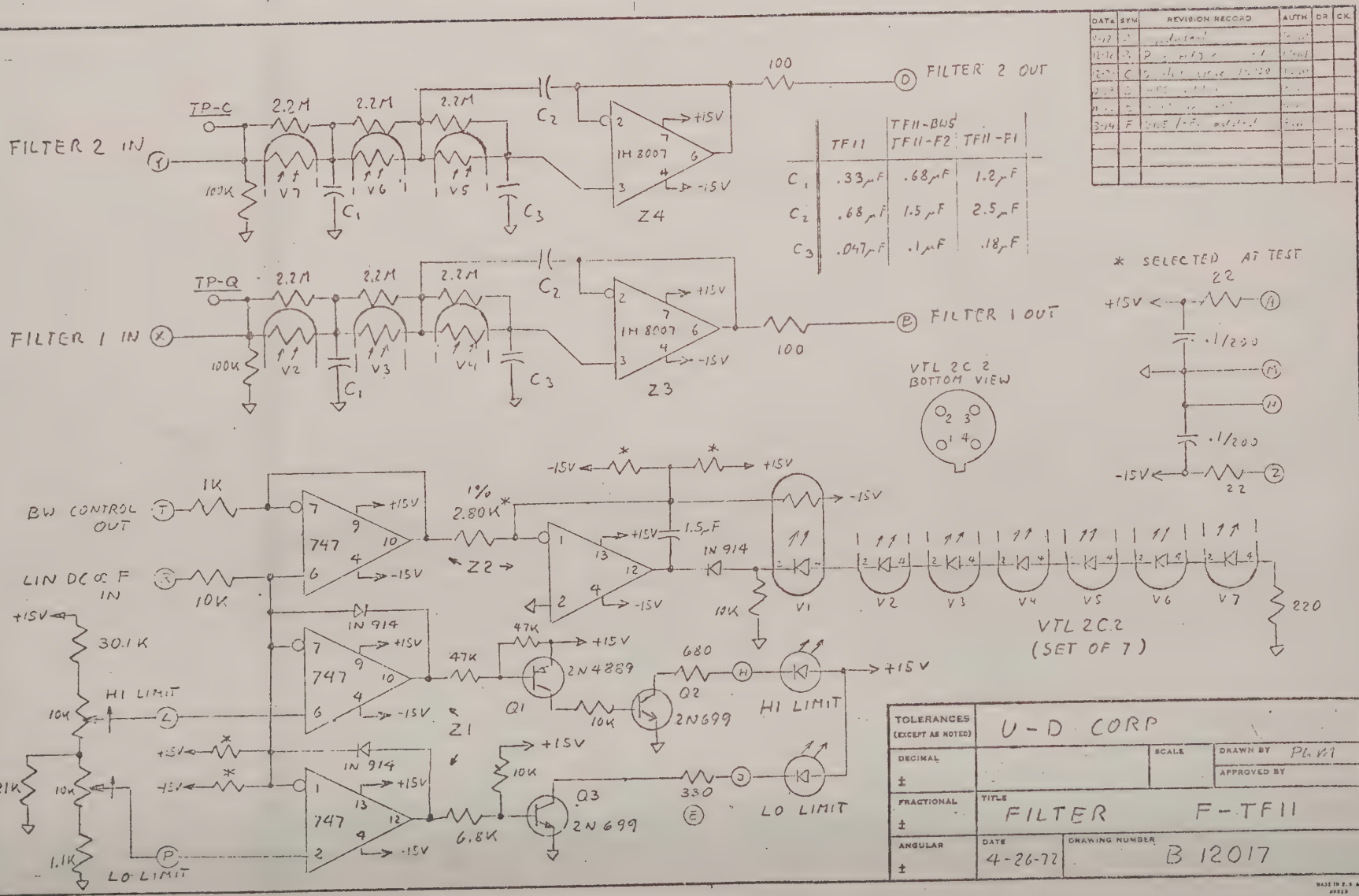
10% 1/4W

1% 1/8W

TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE FULL	DRAWN BY PLM
			APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT D-TF11 MODULATOR		
ANGULAR ±	DATE 5-28-74	DRAWING NUMBER A12067	

FIG. 8.7

K+E ALBANENE © 10 6465 ENGINEERS' STANDARD FORM
MADE IN U.S.A.

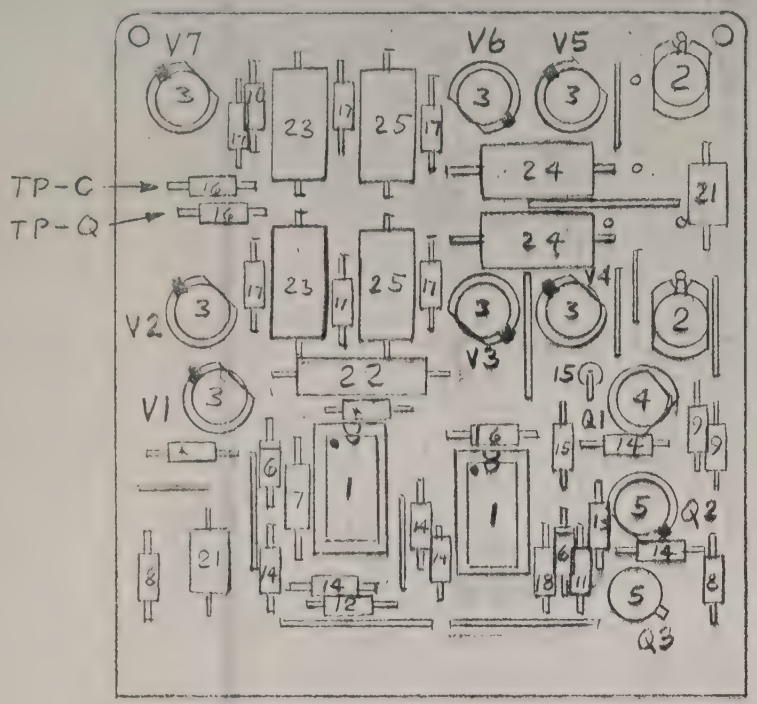


DATE	SYM	REVISION RECORD	AUTH	DR	CK
9-17					
12-16					
12-20	C				
2-21					
3-1					
3-14	F				

TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE	DRAWN BY PL VI
			APPROVED BY
FRACTIONAL ±	TITLE FILTER		F-TF11
ANGULAR ±	DATE 4-26-72	DRAWING NUMBER	B 12017

FIG 8-8

K+E ALBANENE © 10 6403



DATE	SYM	REVISION RECORD	AUTH	DR	CK
8/73	1	- F2 added			
4/73	2	-			
3/74	C	- L21, 1-11 added			

ITEM	QTY	COMP
1	2	μA747
2	2	I-8007
3	7	VTL2C2*
4	1	2N4889
5	2	2N699
6	3	IN914
7	1	1.74K 1%
8	2	22Ω
9	2	47Ω
10	1	100Ω
11	2	680Ω
12	1	1K
13	1	6.8K
14	6	10K
15	2	47K
16	2	100K
17	6	2.2M
18	1	330Ω
19		
20		

¼W 10%

ITEM	QTY	COMP
21	2	.1 μF/50V
22	1	1.5μF/50V
23	2	.33 /50V
24	2	.68 /50V
25	2	.047/200V

* SELECTED
** MATCHED SET

TFII - BW5

ITEM	TFII	TFII-F2	TFII-F1	
23	.33	.68	1.2	} F
24	.68	1.5	2.5	
25	.047	.1	.18	

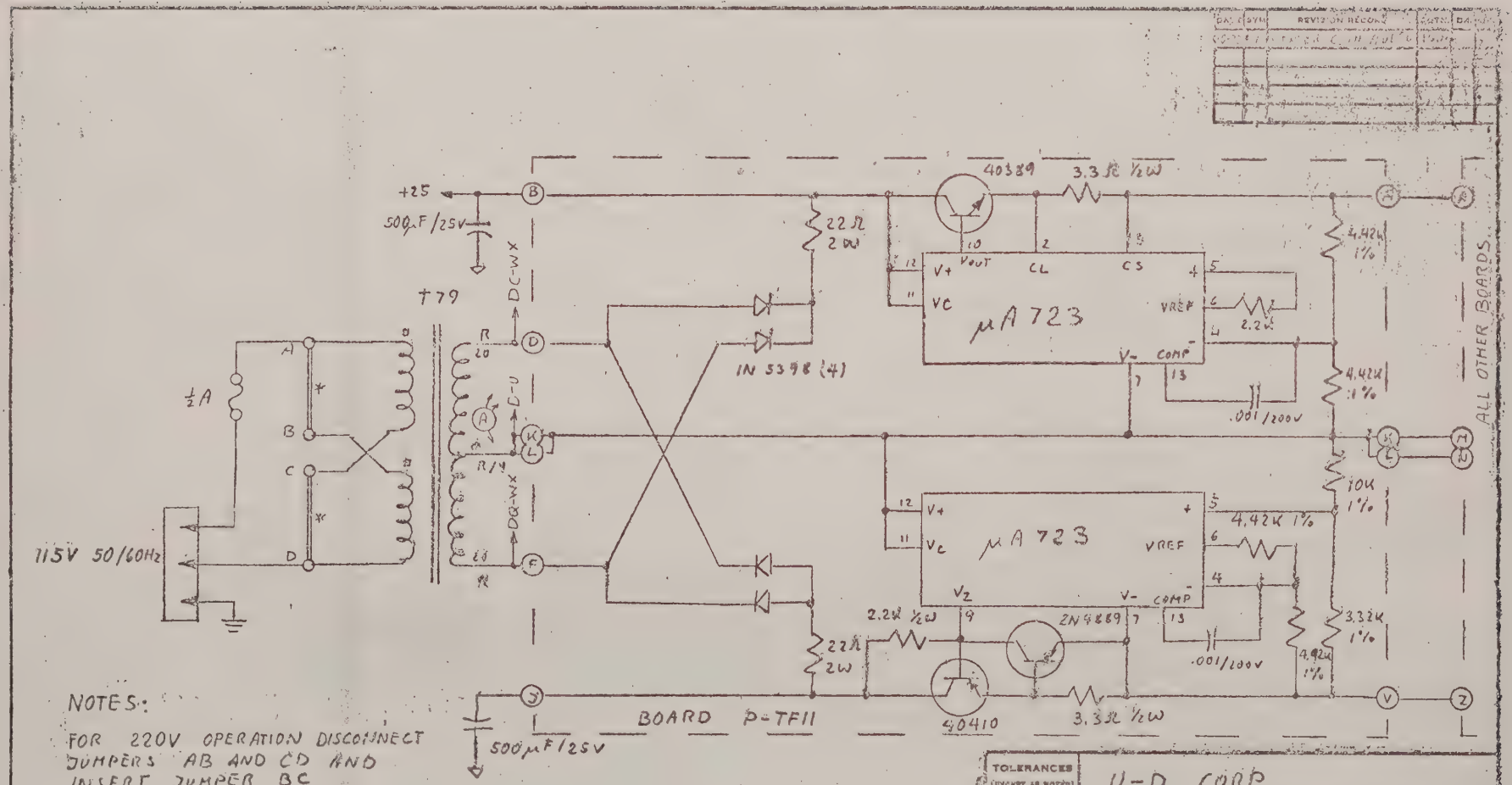
TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE FULL	DRAWN BY PGM
			APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT F-TFII FILTER		
ANGULAR ±	DATE 5-10-73	DRAWING NUMBER A12043	

E16 8.69

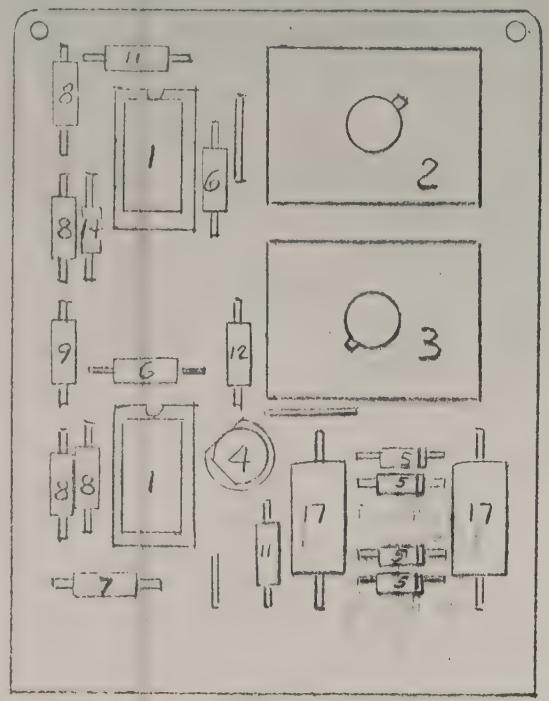
Elec

K+E ALBANENE © 10-5465 ENGINEERING PAPER AND FORM

MADE IN U.S.A. 89-600


+25
500μF/25V
T79
DC-WX
D-U
DC-WX
R
20
R/14
20
R
1/2A
A
B
C
D
115V 50/60Hz
IN 5398 (4)
22Ω 2W
40389
3.3Ω 1/2W
μA723
VOUT
CL
CS
V+
VC
VREF
V-
COMP
2.2K
4.42K 1%
.001/200V
10K 1%
4.42K 1%
3.32K 1%
4.92K 1%
2.2K 1/2W
2N4889
40410
3.3Ω 1/2W
22Ω 2W
500μF/25V
BOARD P-TF11
ALL OTHER BOARDS
NOTES:
FOR 220V OPERATION DISCONNECT JUMPERS AB AND CD AND INSERT JUMPER BC
TOLERANCES (EXCEPT AS NOTED)
DECIMAL
FRACTIONAL
ANGULAR
U-D CORP
SCALE
DRAWN BY
APPROVED BY
TITLE
POWER SUPPLY TF11
DATE
4-26-72
DRAWING NUMBER
B 12019

FIG



DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.

ITEM	QTY	COMP		ITEM	QTY	COMP
1	2	μA 723				
2	1	40389				
3	1	40410				
4	1	2N4889				
5	4	1N5398				
6	2	.001μF/200V				
7	1	3.32K	1/8W 1%			
8	4	4.42K				
9	1	10.0K				
10						
11	2	2.7Ω	1/4W 10%			
12	1	1.5K				
13						
14	1	2.2K	1/4W 10%			
15						
16						
17	2	22Ω 2W				
18						
19						
20						

TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE FULL	DRAWN BY PGM APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT P-TF11 POWER SUPPLY		
ANGULAR ±	DATE 3-29-72	DRAWING NUMBER A 12029	

FIG 8.11

ALBANENE ® 10 5686 ENGINEERING STANDARD FORM

MADE IN U.S.A. 28800

DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
9-24	A	TP-1 ADDED			

MODEL	R (Ω)
TFII-L	10K
TFII-LF2	24.9K
TFII-LF1	49.9K

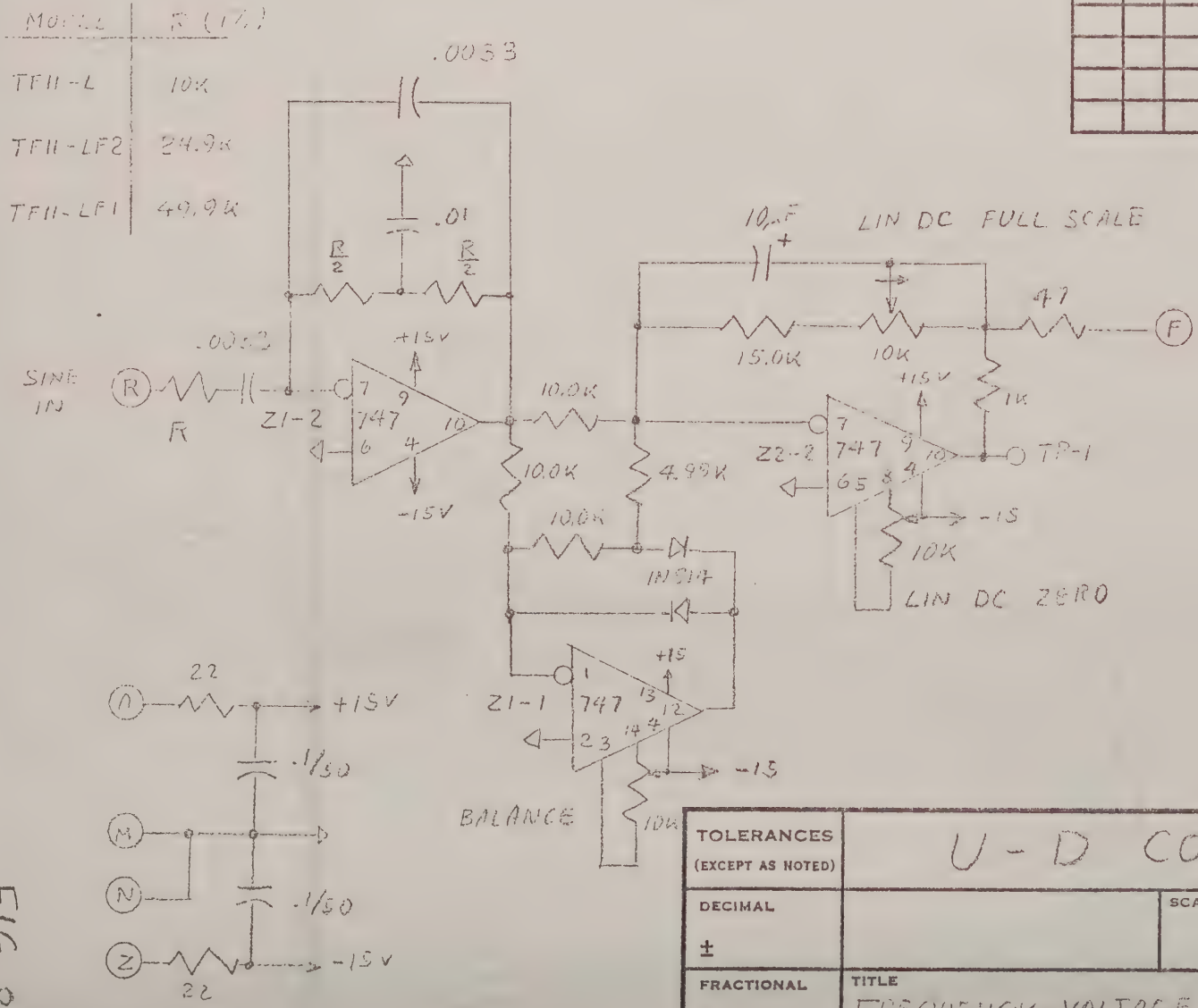
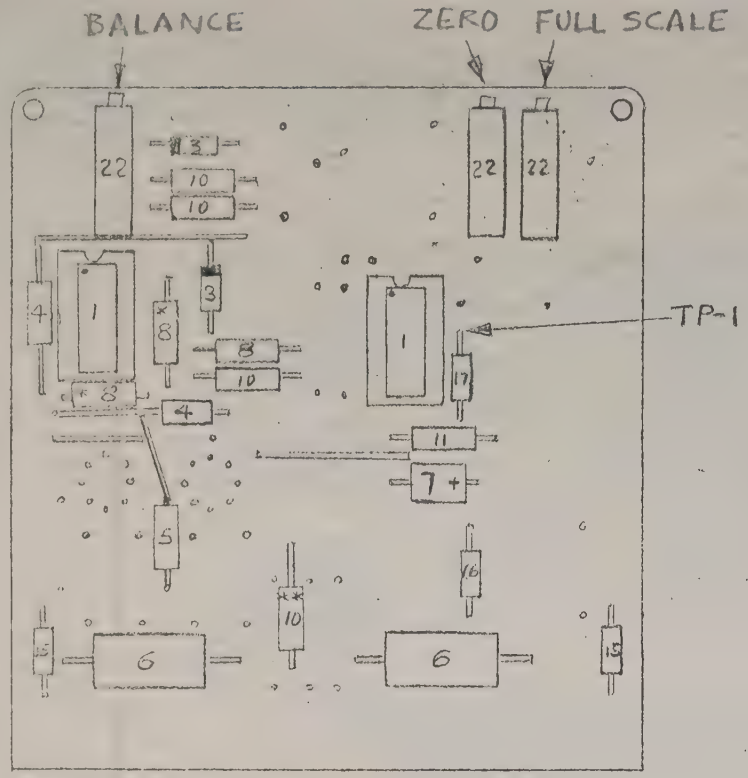


FIG 8.12

TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE	DRAWN BY Pam
			APPROVED BY
FRACTIONAL ±	TITLE FREQUENCY-VOLTAGE CONV L-TFII		
ANGULAR ±	DATE 9-26-73	DRAWING NUMBER A 12048	



DATE	SYM	REVISION RECORD	AUTH.	DR.	CK.
10-73	A	-LF2 added	[illegible]		
4-74	B	[illegible]	[illegible]		

ITEM	QTY	COMP	ITEM	QTY	COMP
1	2	μA 747	21		
2			22	3	10K POT
3	2	IN 914			
4	2	.0033μF/			
5	1	.01μF/200V			
6	2	.1μF/80V			
7	1	10μF/20V			
8	3	4.99K			
9					
10	4	10.0K			
11	1	15.0K			
12					
13					
14					
15	2	22Ω			
16	1	47Ω			
17	1	1K			
18					
19					
20					

1% M.F.

5% 1/4W

(B)

	TF11	TF11-LF2	TF11-LF1
*	4.99K	12.4K	24.9K
**	10.0K	24.9K	49.9K

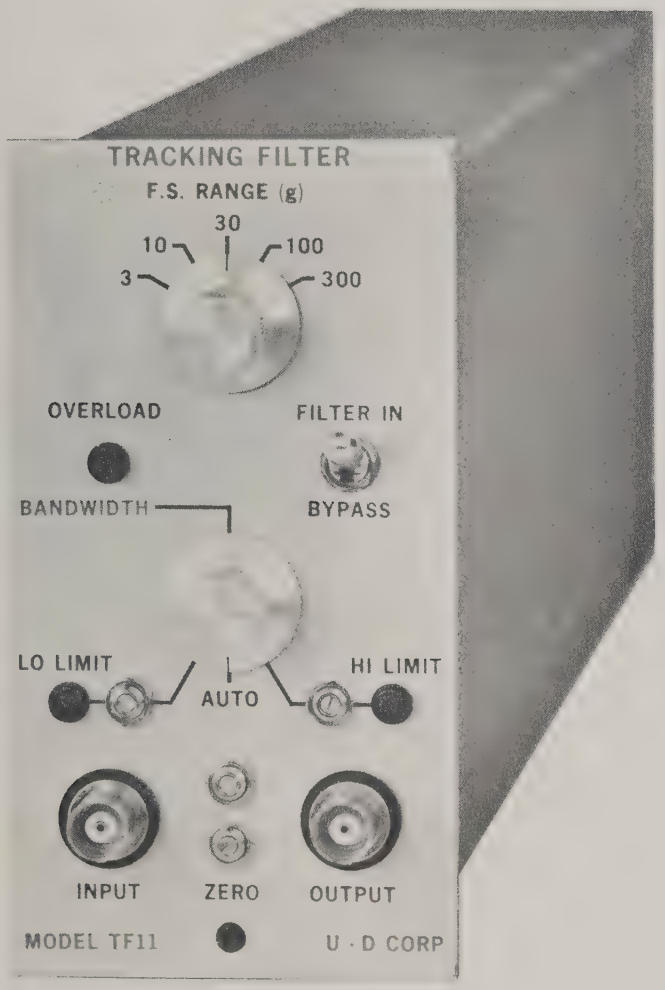
FIG 8.13

TOLERANCES (EXCEPT AS NOTED)	U-D CORP		
DECIMAL ±		SCALE FULL	DRAWN BY PGM
			APPROVED BY
FRACTIONAL ±	TITLE COMPONENT LAYOUT L-TF11 LIN DC GENERATOR		
ANGULAR ±	DATE 9-26-73	DRAWING NUMBER A 12028	

K&E ALBANY N.Y. 10535
MADE IN U.S.A.
26200

MODEL TF11 TRACKING FILTER

ALL THE FEATURES OF UNITS TWICE THE PRICE



COMPACT MODULAR CONSTRUCTION

Any vibration test that requires filtering of one acceleration channel should have filtering available on all channels. The TF11 has been designed as a compact economical instrument to provide the same performance at one half the price and one sixth the panel space of competitive units.

- Continuously variable constant percentage or fixed bandwidth, switch selectable
- Upper and lower bandwidth limits adjustable
- Lower bandwidth limit 2 to 20 Hz
- Upper bandwidth limit 20 to 200 Hz
- Filtered output at unity gain
- Log DC proportional to filtered output
- Six channels in 5¼ X 19" panel
- Interchangeable mounting with Series D22 Amplifiers
- Simplified controls
- Economical
- All integrated circuits
- Overload indicator

MODEL TF11 TRACKING FILTER
SPECIFICATIONS

INPUTS:	**SIGNAL**	
	Frequency range	5 Hz to 5 kHz
	g ranges	3, 10, 30, 100 and 300 g (peak)
	Sensitivity	10 mV peak/g peak
	Impedance	>20 kilohm
	TUNING	
	Frequency range	5 Hz to 5 kHz
	Amplitude	.3 V to 3 V rms sine wave
	Impedance	>20 kilohm
	DC vs FREQUENCY	
	Amplitude	10 mV at 5 Hz to 10 V at 5 kHz, linear DC voltage vs frequency used to program filter bandwidth
	Impedance	> 30 kilohm
OUTPUTS:	**FILTERED SIGNAL**	
	Frequency range	5 Hz to 5 kHz
	Amplitude	Unity gain
	Frequency response	± 0.5 dB
	Impedance	<100 ohm, 2 mA pk-pk maximum
	Linearity	± 0.5 dB ± 0.3% of full scale
	Dynamic range	0 dB to −50 dB at 400 Hz 66 dB (overload to noise floor)
	LOG DC	
	Amplitude	+1 volt/decade. Zero volts at full scale.
	Accuracy	± ¼ dB 0 to −40dB ± 1 dB 0 to −50dB
	Output Impedance	<50 ohms
SELECTIVITY:	Bandwidth	10% of tuning frequency between limits, or fixed at either limit
	Bandwidth limits	Lower limit 2 Hz – 20 Hz Upper limit 20 Hz – 200 Hz
	Filter response	Minimum 50 dB rejection at the ± 8 times half bandwidth points (approximately 3-pole Butterworth)
INDICATORS:	OVERLOAD	Indicates overload of input
	LO LIMIT	Indicates BW is fixed at lower limit
	HI LIMIT	Indicates BW is fixed at high limit
MISCELLANEOUS:	Interlocks	All switches, when changed, provide a signal to place vibration system into STANDBY (no vibration)
	CONNECTORS	
	Inputs and outputs	Rear BNC connectors plus parallel front BNC connectors for input signal and filtered output signal.
	Auxiliary functions	Multipin "D" series rear connector for interlocks and for patching tuning and DC inputs between modules in a multiple channel installation.
	DIMENSIONS	
	Height	5 1/4"
	Width	2 13/16"
	Depth	18"
	Weight	6 lbs
	Power	105-125/210-250 V AC, 50-60 Hz, approximately 10 watts
	Rack Mounting	Uses same Rack Adapter Model 22RA as Unholtz-Dickie Series D22 Charge Amplifiers
OPTIONS:	−L	Integral frequency to linear DC voltage converter for constant % BW control
	−SR	Sine reject output added for combined sine/random testing
	Phase matched	Channels matched within ± 1° phase similarity from 5 to 5000 Hz
	−8	8¾" front panel height to match −8 charge amplifier modules

UNHOLTZ-DICKIE CORPORATION

3000 Whitney Avenue, Hamden, Connecticut 06518

Area Code (203) 288-3358

Bulletin TF11-74
Printed in U.S.A.

VIBRATION TEST EQUIPMENT

- VIBRATION TEST SYSTEMS
- VIBRATION TRANSDUCER CALIBRATION SYSTEMS
- RANDOM ACCESSORIES
- COMBINED SLIP TABLE ASSEMBLIES
- AUTOMATIC SINE CONTROLS
- LOW COST TRACKING FILTERS
- SIGNAL CONDITIONING AMPLIFIERS
- ACCELEROMETERS

manufacturers of shaker systems, advanced instruments and accelerometers

UNHOLTZ-DICKIE CORPORATION

3000 WHITNEY AVE. HAMDEN, CONN. 06518 (203) 288-3258

INTRODUCTION

Vibration testing has been a major tool used in the development of military and space hardware for over 25 years. Today, the benefits of vibration testing are being applied in a variety of commercial and consumer product areas as well. This trend parallels an increasing number of federal regulations which require more comprehensive testing to assure product reliability and safety.

Vibration testing can genuinely benefit the manufacturer. By simulating environmental vibration levels during actual product development, the engineer can verify that a design is suitable for its application. This type of testing establishes performance and reliability prior to release of a design for production. Such an approach can save money by minimizing the probability of major redesign work, and even legal liabilities which may result from an inadequate product design. In addition, quality control procedures can be enhanced by using vibration testing as a tool to monitor the consistency of production methods and materials.

Electrodynamic shaker systems are used in a variety of test applications. A typical arrangement for automatic sine testing is shown in FIG. 1. Such a setup provides automatic frequency cycling at preselected vibration levels, under servo control. A typical test "program" is shown in FIG. 2.

Figure 1. **SETUP FOR AUTOMATIC SINE TESTING**

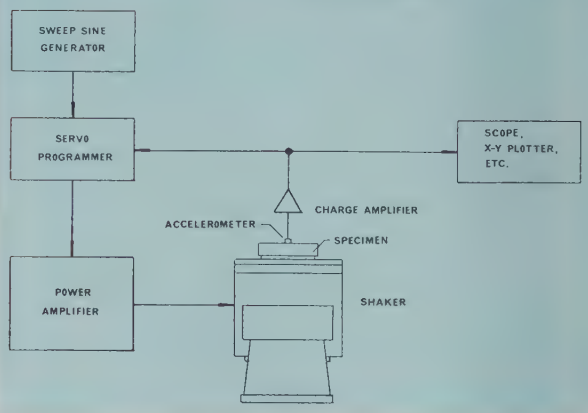
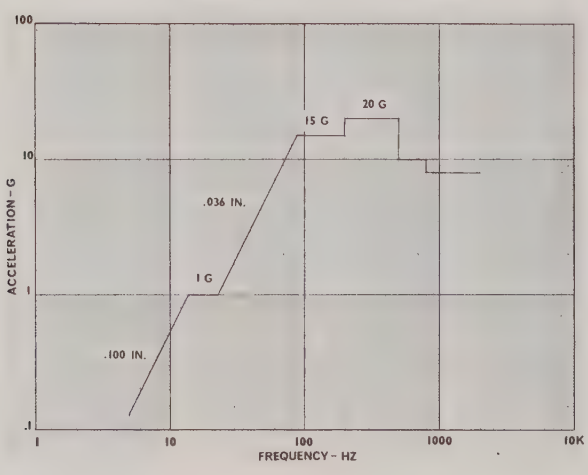


Figure 2. **EXAMPLE OF TEST PROGRAM**



The block diagram above could represent any of a wide variety of available vibration test systems. Unholtz-Dickie, the industry leader in solid state powered shaker systems, offers a complete line of vibration test systems as well as a full complement of signal conditioning and control instrumentation. See page 3 for a convenient listing of Unholtz-Dickie shaker systems. The remaining pages describe many of the instruments and system accessories that have helped make Unholtz-Dickie today's number one manufacturer of vibration test equipment.

The purpose of this short form catalog is to summarize the standard vibration test equipment manufactured by the Unholtz-Dickie Corporation. Detailed information on the many systems and related accessories is available on request.

VIBRATION TEST SYSTEMS

Unholtz-Dickie produces vibration test systems for all test applications. Sine force ratings range from 50 to 20,000 pounds. The table below lists these systems, with pertinent technical data. Special systems, including those with multiple shakers are also available.

Every Unholtz-Dickie system includes a safe, reliable, proven solid state power amplifier, and features reliable air cooling of the shaker armature. Systems engineering of each system element assures maximum performance and utilization, with simplified operation.

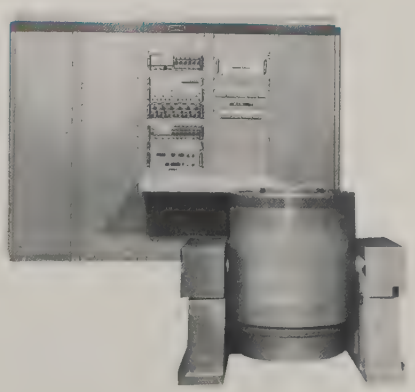
SYSTEM PERFORMANCE				SHAKER	
FORCE (lbs)		STROKE (inches, DA)	MAX. SINE PAYLOAD (lbs) at 20g	ARMATURE WEIGHT (lbs)	TABLE DIA (inches)
Sine (pk)	Random (rms)				
50	—	0.5	1.8	0.69	2
50	—	1.0	1.9	0.55	drive rod
150	—	4.0	5.2	2.25	drive rod
250	125	1.5	9.7	2.75	3.5
300	180	1.5	12.2	2.75	3.5
500	300	1.0	19.7	5.3	4.5
1,000	—	6.0	39	11	drive rod
1,200	600	1.0	46	14	5.75
1,200	600	1.0	40	20	8
1,700	850	1.0	65	20	8
3,000	2,200	1.0	134	16	5.75
3,000	2,200	1.0	128	22	8
3,800	2,200	1.0	162	28	8
6,000	3,000	1.0	264	36	12
6,000	4,500	1.0	264	36	12
8,000	4,000	1.0	310	90	16
12,000	6,000	1.0	510	90	16
12,000	8,000	1.0	505	100	16
17,500	12,000	1.0	780	95	16
17,500	15,000	1.0	780	95	16
19,500	14,000	1.0	880	95	16
20,000	18,000	1.0	905	95	16

INDUCT-A-RING

The Unholtz-Dickie INDUCT-A-RING Shaker features a solid metal, single turn armature coil for maximum reliability in a high performance machine. AC currents are induced into the metal ring, eliminating the need for current connections to the armature. This exclusive air cooled armature provides unmatched ruggedness and service life. INDUCT-A-RING Shakers are available in 12,000 pound force systems and up.

SOLID STATE POWER

Unholtz Dickie pioneered the use of solid state power amplifiers for driving electrodynamic shakers. The present design has demonstrated reliable performance since early 1968. No power transistors since introduced on the market offer the promise of better performance and reliability. Today, amplifiers with output ratings to 200 kVA are offered. Direct coupling to the shaker provides superior low frequency performance, such as 1 inch peak-to-peak displacement at 2 Hz, as required by some MIL-STD-810B procedures.



19,500 pound system with 120 kVA solid state power amplifier and INDUCT-A-RING Shaker, shown with optional instrumentation.

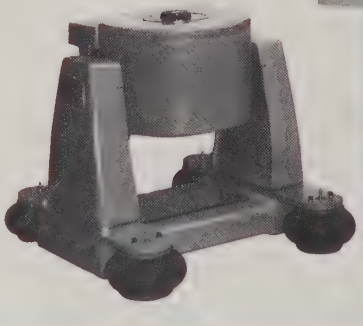
SERIES 300
VIBRATION TRANSDUCER
CALIBRATION SYSTEMS

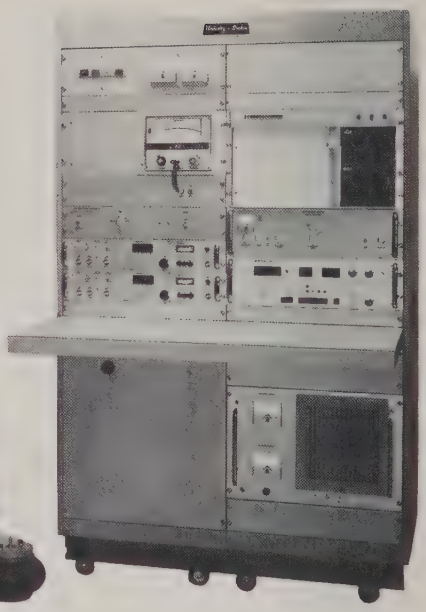
The Series 300 Calibration Systems are offered with manual controls for point by point calibration, or with frequency sweeping controls giving an automatically drawn curve of % deviation of the "unknown" transducer sensitivity relative to the "reference" accelerometer, as a function of frequency. Original data is permanently plotted, eliminating operator errors in readout and transcription.

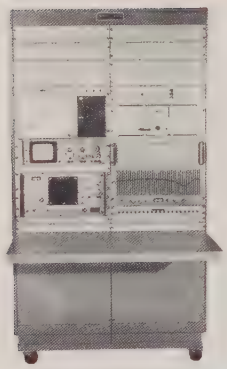
At full system performance, and with automatic servo controls operating, acceleration waveform distortion is less than 1.5% at all operating frequencies. The overall system noise level is less than .005 g rms. Automatic plotting systems feature 0.25% plotting resolution of the unknown transducer output relative to the reference.

Model 351

Automatic Recording Vibration Calibration System with Optional VI100 Shaker Vibration Isolation

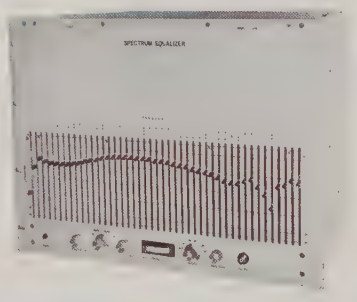






RANDOM ACCESSORIES

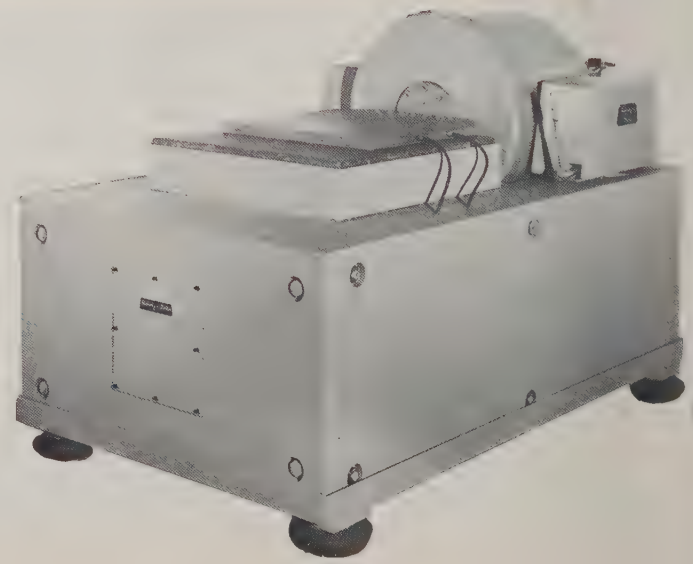
Complete random testing capability is available with systems-engineered random controls. A typical remote random control console configuration is shown here.



Random Accessories include the Model E109B Spectrum Equalizer, featuring 45 active filters with individual, rectilinear motion attenuation controls. Convenient equalization can be performed using this unit in conjunction with a real time analyzer.

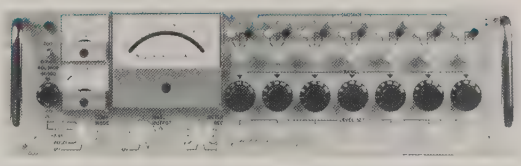
PERMALINE
COMBINED SLIP TABLE ASSEMBLIES

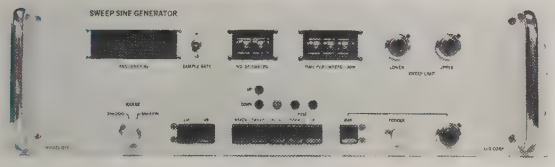
The PERMALINE Combined Slip Table Assembly provides for testing in three axes while using only one fixture. Permanent factory alignment of the shaker and slip plate allows quick change from vertical to horizontal operation. In addition, no special floor construction is required since inflatable air mounts effectively isolate the entire assembly from the supporting structure.



AUTOMATIC SINE CONTROLS

Model SP-7 Servo Programmer features amplitude servo, vibration meter, seven segment programmer, and optional charge amplifier for automatic, multi-level sine testing. All controls are interlocked to prevent damage to the test specimen. Model SP-2 Servo Programmer features two segment programmer.





Model OSC-1 Sweep Sine Generator is systems engineered to provide the vibration test system input sine wave signal for continuous cycling over a 3-decade frequency range. Unit features digital counter frequency display that can count and display ten times per second regardless of the operating frequency.

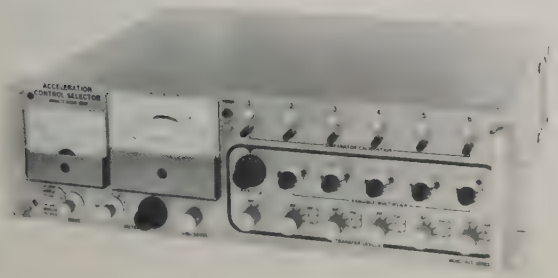
SPECIAL CONTROLS

Model AM-122 Acceleration Monitor and Limiter offers independent vibration system overtest protection in the event of equipment failure or mis-operation of the system control channel. Shutdown is obtained by use of an adjustable meter relay and solid state signal conditioning circuitry.

Model TF11 Tracking Filter features a constant 10 percent bandwidth between the limits of 2 and 200 Hz, plus a standard log DC output for X-Y plotting. All this in a compact unit, at an attractive price.

Model MAC-8 Multifunction Averaging Control features eight individually selectable data channels for control to the average signal level. Can be used for sine or random vibration testing.

Model RD-1 Resonant Dwell Control automatically maintains the vibration testing frequency at the resonant frequency of a test specimen during endurance testing.

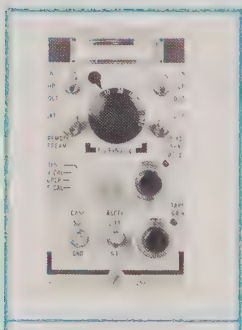


Model ACS-6 Acceleration Control Selector automatically switches to the highest (or lowest) acceleration input. Accepts six sine acceleration signals, and gates to the output whichever signal reaches its preset limit.

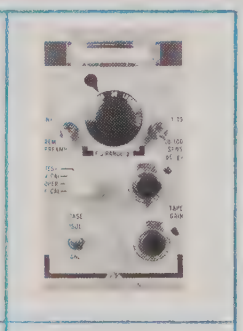
SIGNAL CONDITIONING AMPLIFIERS

D22 SERIES

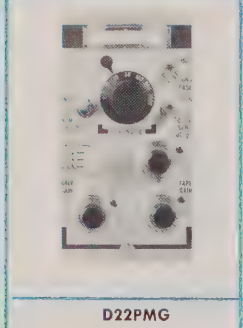
The D22 Series provides charge amp signal conditioning for all piezoelectric transducers. Some models also provide for strain gage operation. This series features all integrated circuit design with superior low noise characteristics, in a rugged modular construction. The basic Model D22PM includes the capability of operating with a remote preamp, and includes a meter. This and other standard models are shown below. The wide range of optional features available for addition to most models, is listed below.



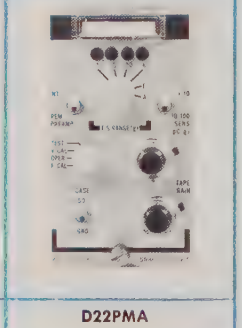
D22PMH



D22PM



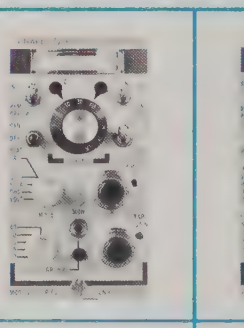
D22PMG



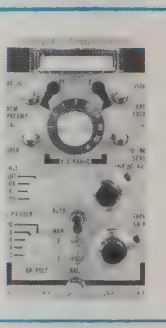
D22PMA

D22 OPTIONS

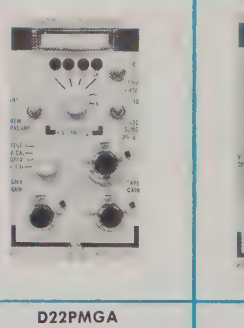
Description	Suffix
STRAIN GAGE OPERATION	R
HIGH TEMP ACCEL. INPUT	H
BRIDGE CONDITIONER	B
10 mV/g SERVO OUTPUT	S
100 mV-SEC/IN. VEL. OUTPUT	I
1 V/IN. DA DISP. OUTPUT	II
LINEAR DC OUTPUT	F
LOG DC OUTPUT	L
REMOTE RANGE CONTROL	E
AUTORANGING	A
±100 mA LINE DRIVER	C
±100 mA GALVO OUTPUT	G
CALIBRATION OSCILLATOR	O
TRACKING FILTER CONNECTION	T
0.5 HZ FREQ. RESPONSE	–2
EXTRA X10 GAIN	–3
FS RELAY CALIBRATION	–4
LARGE 2½" SCALE METER	–8



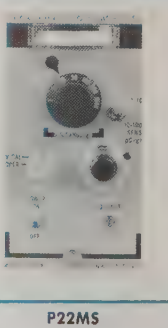
D22PMR



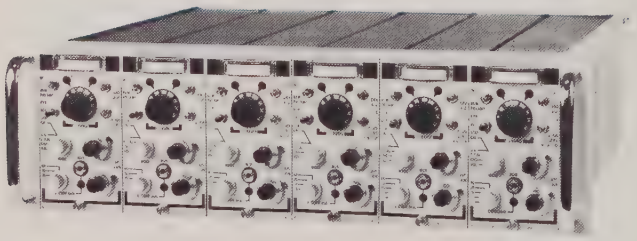
D22PMB



D22PMGA

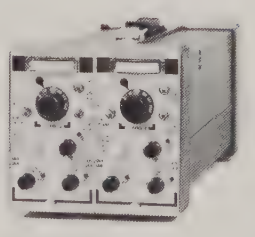


P22MS



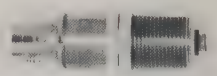
22RA

The Model 22RA Rack Adapter accepts six 22 Series modules in the standard 5¼ inch panel height. Also accepts the Model TF11 Tracking Filter (see page 5).



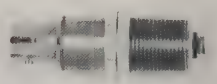
22P2

The Model 22P2 Dual Channel Portable Adapter accepts two channels of 22 Series instruments.



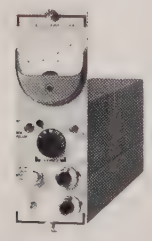
11PA-2

The Model 11PA-2 is a two-wire Remote Voltage Preamp designed for use with any of the 22 Series instruments.



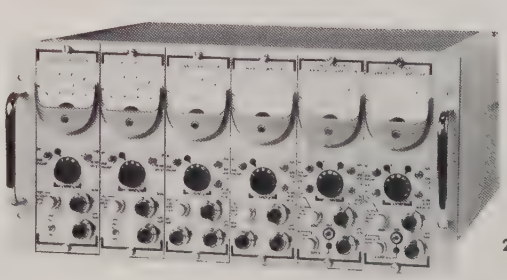
22CA-2

The Model 22CA-2 Remote Charge Preamp may be used with any of the 22 Series instruments shown above, and is a companion unit to the Model P22MS. Optional Model 22CA-2T is available for operation to 160°F.



D22PM-8

Models D22PM and D22PMR are available with the "–8" option, which provides a 2½ inch meter scale for easier readout.



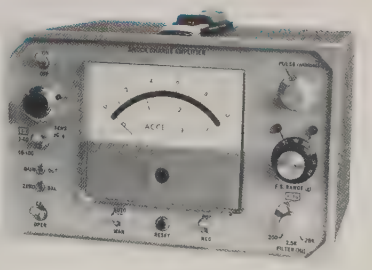
22RA-8

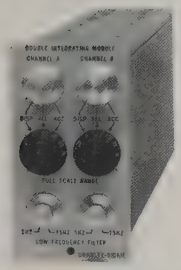
Rack mounted D22's with the "–8" large meter option require the 22RA-8 Rack Adapter with 8¾ inch panel height. Each 19 inch adaptor accepts six "–8" modules.

SIGNAL CONDITIONING PRODUCTS

Model SA22 Shock Charge Amplifier measures shock pulse durations from 100 microseconds to 500 milliseconds and pulse amplitudes up to 100,000 pC peak.

Model SA22TPM Portable Shock Charge Amplifier provides the same shock pulse measurement capability as the SA22, but also features a Transient Peak Meter for retaining peak g readings.

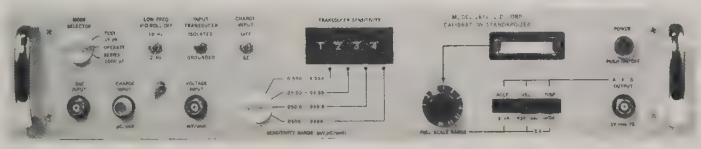




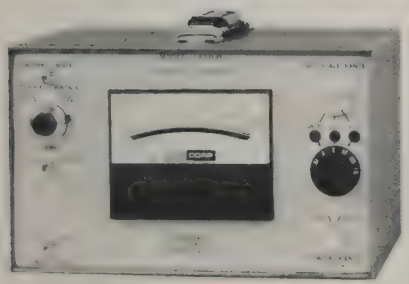
Model AVD-22M provides two channel, double integration of conditioned 10 mV/g acceleration signals. Each channel has tape and X-Y plotter outputs, plus normalized velocity and displacement outputs. Unit features 80 dB dynamic range and switchable low frequency filtering.

Model CV22PM-LF1 charge/voltage amplifier, operates down to 0.1 Hz. Combines capabilities for low level, low frequency vibration measurements and long duration shock pulse measurements.

Model LDC-22 provides two channel conversion to log DC of conditioned 1V peak full scale input signals for X-Y plotting. Features 5-10,000 Hz frequency response, 60 dB dynamic range, and selectable damping.



Model 1611 Precision Charge/Voltage Calibration Standardizer features typical ¼ percent overall instrument accuracy and stability. Frequency response from 2 Hz to 20,000 Hz. Used in transducer calibration systems, or wherever maximum accuracy is required.



Model 1610 Series Double Integrating Charge/Voltage Monitors are available in three standard models: 1610M (single channel, portable) 1610RM (single channel, rack mounted), and 2610 (dual channel, rack mounted). Switch selectable outputs for acceleraton, velocity, or displacement are provided along with log scale meter readout. Log DC and variable gain galvo outputs are optionally available.

ACCELEROMETERS

Unholtz-Dickie produces a full line of piezoelectric accelerometers for general purpose vibration testing and for special applications. Various models are optimized to provide features such as subminiature size, high sensitivity, high frequency operation, and normalized 10 pC/g sensitivity.

MODEL	PERFORMANCE FEATURES	NOMINAL: OPEN-CIRCUIT VOLTAGE SENS. mV-pk/g-pk	NOMINAL: CHARGE SENSITIVITY pC-pk/g-pk	NOMINAL: USEFUL FREQUENCY RANGE-Hz	NOMINAL: SIZE-INCHES WEIGHT-GRAMS	DESIGN FEATURES
2E3	**Subminiature, extremely small,** lightweight, for highest frequencies and minimum added mass.	2.5	1.0	1.0 TO 12000	HT .310 DIA .220 WT 1.22	Shear, side connector, integral cable, molded neoprene strain relief boot, adhesive mount, lead zirconate-titanate crystal. 2E5 has wrenching flats for easy removal.
2E5	Relatively large voltage and charge outputs. Low base strain sensitivity construction.				HT .310 DIA .280 WT 1.36	
2D21	**Subminiature, lightweight,** with low base strain sensitivity construction. Removable cable.	3.0			HT .415 HEX .280 WT 1.31	Shear, top connector, wrenching flats for easy removal, lead zirconate-titanate crystal.
5D21-8	**Miniature, general purpose,** moderately high resonance, low base strain sensitivity, recommended for charge use.	5.0	8.0	0.2 TO 7000	HT .64 DIA .50 WT 10.7	Shear, top connector, 10-32 mounting hole, lead zirconate-titanate crystal. Stainless steel case.
10DQ21	**General purpose,** side connector for restricted height applications. Low base strain sensitivity.	20	40	0.2 TO 6000	HT .71 HEX .62 WT 25	Shear, side connector, 10-32 mounting hole, lead zirconate-titanate crystal. Stainless steel case.
75D21	**Maximum voltage and charge sensitivity** gives best signal/noise ratio for low level measurements. Low base strain sensitivity.	75	82	0.3 TO 4000	HT .74 HEX .75 WT 37	Shear, top connector, 10-32 mounting hole, lead zirconate-titanate crystal. Stainless steel case.
10B10	**Charge sensitivity normalized** at 10 pC/g. Wide temperature range, −300°F to +500°F. Flat voltage and charge sensitivities. Low base strain sensitivity.	3.1	Set at exactly 10.0	1.0 TO 4000	HT .78 HEX .62 WT 27	Double base, compression, side connector, 10-32 mounting hole. Bismuth strontium titanate crystal. Stainless steel case.
10B10T					HT .81 HEX .62 WT 29.5	Same as 10B10 but with top connector.
A-1 Probe	**General purpose** hand-held accelerometer for vibration survey.	3.5	5.2	0.3 To 600 (hand-held)	LGH 5.25 DIA .62	Shear mode, hand-held, aluminum case with stainless steel tip.
1000 PA	**High sensitivity, low noise,** and low output impedance permit very low level measurements at low frequencies. Excellent signal/noise ratio is maintained even with long runs of low cost cable.	1000	NA	0.1 TO 2000	LGH 1.0 WD 1.0 HT 2.06 WT 110	Shear mode, with integral electronics and 4-pin side connector. 10-32 mounting hole or optional magnetic base. Sealed aluminum case.
100 PA		100				

manufacturers of shaker systems, advanced instruments and accelerometers

UNHOLTZ-DICKIE CORPORATION

3000 WHITNEY AVE. / HAMDEN, CONN. 06518 / (203) 288-3358

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UNHOLTZ - DICKIE CORPORATION
Vibration Engineering Specialists
3000 WHITNEY AVE.
HAMDEN, CONN. 06518
(203) 288-3358

WARRANTY

All products are warranted to be free of defects in material and workmanship for a period of one year from date of shipment. If the product is not installed, maintained and used in a normal manner in accordance with instructions and manuals, this warranty will not apply. Commercially available instruments and accessory items purchased and installed in the product will carry the original manufacturer's warranty.

This warranty is limited to repairing or replacing parts which have been returned and in our opinion are defective. Service required to correct defects in material or workmanship will be supplied without charges. The Buyer will pay all transportation and taxes incurred. This warranty does not cover any costs incurred by the Buyer as a result of purchase of UNHOLTZ-DICKIE CORP. equipment or any charges for the Buyer's labor for replacement, adjustment or repair unless authorized in advance in writing. We are not liable for consequential damages.

This warranty will not apply to any products which, in the opinion of UNHOLTZ-DICKIE CORP., have been subject to accident, misuse or neglect; altered or repaired with a substitute which might impair the product; or used outside of rated conditions. UNHOLTZ-DICKIE CORP. reserves the right to make improvements in its products including changes and additions without incurring obligations to incorporate such improvements in previous units.

This warranty is expressly in lieu of any and all other warranties or commitments, expressed or implied and any other obligations to the Buyer associated with the use of UNHOLTZ-DICKIE CORP. products.

4/1/73

UNHOLTZ-DICKIE CORPORATION

Incoming Instrument Inspection

and

Return Shipping Instructions

1. Unpacking and Inspection

If the shipping carton is damaged, note on acceptance that it is received damaged and subject to claim when inspected. Ask that the carrier's agent be present when the instrument is unpacked and inspected for damage (scratches, dents, broken knobs, etc.). If the instrument is damaged or fails to meet specifications, notify the carrier and the Unholtz-Dickie Corporation immediately. Retain the shipping carton and the padding material for possible return for repair or further inspection by carrier. The purchaser and Unholtz-Dickie Corporation will arrange for the replacement and/or repair of the damaged item.

Refer to our separate warranty page for a statement of our warranty policy.

2. Return Shipment

Return shipment procedure: Please be sure the following instructions are observed if a Model 22 Series instrument is being shipped back to Unholtz-Dickie for repair, replacement, or upon completion of use as a demonstrator or loaner.

2.1 Size of Box and Packing Instructions

2.1.1 Single Channel with 5¼ inch Panel Height

If the single channel was shipped from Unholtz-Dickie as an individual unit, replace the instrument in its original container. If the instrument was shipped as part of a rack mounted combination of channels, the single channel can be returned separately in a container that is no smaller than 22½ inch x 10½ inch x 9½ inch. The front and rear panels must be completely protected by approximately 2 inches of cushioning material. The top, bottom and sides must be surrounded by cushioning and filler materials. A strong, double wall type corrugated box, (350 lb/sq. in. minimum bursting test) has been proven to give adequate service. DO NOT USE A SMALLER OR WEAKER CONTAINER THAN THAT RECOMMENDED ABOVE.

Cover the painted surfaces of the instrument with protective wrapping paper or a plastic bag whenever the packing material might be coarse enough to scratch the painted surfaces.

2.1.2 Six Channel Rack with 5¼ inch Panel Height

CAUTION: Do not rest the rack type instrument in a vertical position with its weight on the rear since the connectors and switches at the rear of the instrument might be damaged.

Replace this instrument in the original container. Replace all packing pads and fillers in the exact position which they originally occupied. If the original container is no longer available, use a container that is no smaller than 27 inch x 20½ inch x 10½ inch.

It is important that protection be provided for the rear connectors and switches during shipment. A sheet of stiff cardboard should be placed under the instrument and then folded up to meet the top of the rear panel. The instrument should be bagged and surrounded on all surfaces by cushioning and filler materials. A strong, double wall type corrugated box (350 lb/sq. in. minimum bursting test) has been proven to give adequate service. DO NOT USE A SMALLER OR WEAKER CONTAINER THAN THAT RECOMMENDED ABOVE.

2.1.3 Single Channel with 8-3/4 inch Panel Height

Follow the instructions given in paragraph 2.1.1, except that extra precautions must be taken to prevent the front panel extension with its meter from being bent during shipment. The extended meter must be braced between packing material so that the load force will be distributed evenly over the entire front panel of the instrument.

2.1.4 Six Channel Rack with 8-3/4 inch Panel Height

Follow the instructions given in paragraph 2.1.2, except that the container size must be no smaller than 26½ inch x 25 inch x 13½ inch.

UNHOLTZ-DICKIE CORPORATION
2994 Whitney Avenue/Hamden, Conn./Area Code 203 288-3358

www.manualsplus.com
1026019